Rock&Gem

JUNE 2007

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ROADMAP TO TREASURE

COLLECTING'S PAST, PRESENT AND FUTURE

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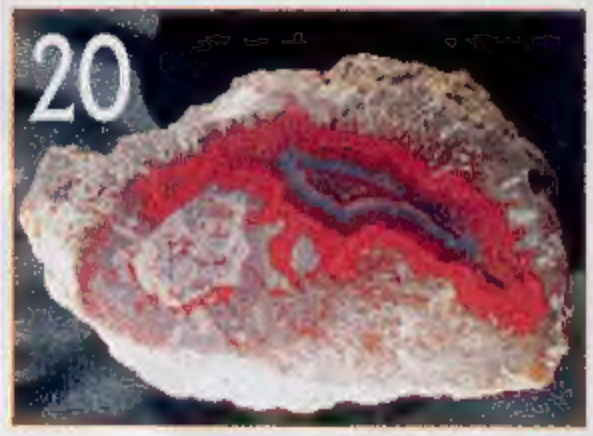

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Needle sprays of the zeolite mineral mesolite (center) are surrounded by a calcite crystal (top right), purple fluorite, red vanadinite, and rose quartz. (Earl Lewis photo/Keith Proctor collection)

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THE HISTORY OF MINERAL COLLECTING

During the early days of mining silver in Germany, the aesthetics of minerals were first appreciated and specimens were collected for display.

When Did It Become a Hobby?

Story and Photos by Bob Jones

Where would humankind be if we did not collect minerals? The hobby has given hundreds of thousands of ordinary folks lots of pleasure, intellectual stimulation, and outdoor exercise. Amateur rockhounds have helped develop an interest in science in others and have certainly contributed to the science itself. Mineral collecting has given the average person something to be proud of doing and owning. And think of all the really great people you have met thanks to this wholesome hobby.

When did all this rockhounding and mineral collecting really begin? Early humans gathered colorful and useful rocks thousands of years ago, but they did it out of necessity. When did we start doing it just for fun?

Early mineral collecting was largely motivated by survival. Early humans were hunters and gatherers, not farmers. They collected fruits, seeds and nuts to supplement a diet of meat, which they hunted using weapons made first from wood, then from stone. Certain minerals

like flint and obsidian were collected where available, for they served as useful tools or weapons.

These people did not have an established home base. They lacked any knowledge or opportunity to gain knowledge about minerals. Only an innate curiosity propelled humans to pick up the oddly colored stone or curiously shaped mineral, but they did not make a habit of it for the obvious reason that they could not haul a bunch of rocks around as they pursued their food supply.

A second reason to collect had to do with superstition and religion. Humans attributed magical powers to certain stones. American Indians were devoted to turquoise. They believed it was a gift of the gods in the sky because of its sky-blue color. Other minerals were collected because they were easily crushed and used for decorating the face and body. Some felt these colorful substances—the word "mineral" had yet to be coined—imparted protection or certain powers not otherwise available. Amulet stones came into use because they were believed to possess some special quality or magic.

Gradually, humans began to recognize that certain minerals had properties that were useful for something beyond tools, weapons, and magical powers. People began to use powdered minerals to color pottery. This eventually resulted in humans exploring for more useful minerals. In other words, the business of prospecting was born!

From pottery, humans moved to the art of metal smelting over 8,000 years ago. Once people found that certain rocks could yield useful metals, they began working toward a more scientific understanding of minerals. The minerals that would produce metal were identified by their visible physical properties.

Metal smelting became more technical and efficient. Information about the properties of certain minerals, discovered through observation over a long period of time, was jealously guarded

Malachite was collected over 4,000 years ago for use in producing copper. Later, it became a favorite decorative stone.

and shared only with a family member. These people, known as metalsmiths, were a given special status in society, such as in the early cultures of Egypt. When copper carbonates were being collected for the smelting process, colorful stones like agates and turquoise were also collected. They were given value and used for decorative purposes. All this sets the stage for the hobby's emergence.

Beginning about 1,000 A.D., silver discoveries were being made, especially in Germany. By the 1500s, enough practical evidence about minerals and their properties had been accumulated to allow miners to evolve a more precise method of extracting the Earth's riches. As the mining of metals, particularly silver and gold, had reached quite sophisticated levels, more and more people became learned in the properties of certain minerals and used that knowledge to advantage. Others collected minerals, not to obtain metals, but to obtain more knowledge.

Keep in mind that mining as we know it today did not exist. Mines were exclusively the property of royalty. If a mine was producing something really valuable, you can be sure the royal owner enjoyed showing off some of the natural riches coming forth.

Beginning about 900 A.D., Germany's silver mines poured forth vast wealth, which had a positive impact not only on society's emergence from the Dark Ages, but on the dissemination of knowledge. Successful mining in Germany and the natural curiosity of people to learn more about what they had in hand eventually led to the establishment of the first mining academy, where minerals were studied to gain a better understanding of their properties and uses. This required academics to collect minerals for study. The stage was now set for collecting as a hobby to emerge.

The literature cites the year 1530 as the best-guess date for our hobby's birth. In this year, a book was published that made reference to a personal collection. Written in Latin, *De Natura Fossilium*, is a remarkable compendium of the mystic and real sciences dealing with minerals. The German doctor who is responsible for that record, Georg Bauer, also wrote about minerals and mining under the pseudonym Agricola. We can thank Herbert Hoover, a professional mining engineer, and his wife for translating this text into English. Of course, Hoover is better known as a president of the United States.

continued on next page

When silver was found in Norway in the 1500s, the king took ownership of the source and made it illegal for people to collect specimens.

Ancient peoples mined malachite to use as a coloring agent in their pottery, a use that first revealed how ores could be smelted.

Early miners used any means they could to mine ore but had little time to collect specimens.

Agricola's later book *De Re Metallica* revealed the long-held secrets of successful mining in Germany, techniques developed in German mines through the previous five centuries. Agricola's writings were so useful to miners and mining engineers that they were used right into the 20th century.

Europe, at that time, was slowly emerging from the Dark Ages, which had fragmented the continent politically. The discovery of silver helped fund the rebirth of an enlightened Europe. Prior to that, Europe was sectioned into principalities, small fiefdoms, and areas ruled by a local prince, duke, king, or other form of royalty. When valuable minerals like silver and gold were found in one of these fiefdoms, the mines and their wealth became the property of the local royal. In addition to accumulating the wealth coming from the mines, these royals would keep some of the showy or unusual mineral specimens.

A good example is the amazing silver deposit in Kongsberg, Norway. The two young shepherds who found a shiny metal in a rock gave it to their father, who knew what it was. He attempted to sell it and was promptly arrested. The name of the mining region and the nearby city, Kongsberg, means "King's mountain." The King owned the silver, and only the king could acquire specimens for display. That meant it was virtually illegal for anyone else to be a collector!

Luckily, some wealthy royals patronized the sciences, which were also emerging from the Dark Ages. Accurate knowledge of mines, mining and minerals directly improved the production of silver or gold through patronage, particularly of the mineral sciences, mining and metallurgy. Inevitably, interest in minerals gradually took hold. This resulted in the establishment of Germany's earliest mining academy at Schemnitz, a region in the heart of German silver mining country, in 1735. Through the mining academy, the secrets about mining and minerals that had been so jealously guarded were revealed to anyone who had the interest and financial ability to study the science.

It was only natural that the royal mine owners would visit their mines. Miners took pride in presenting their royal visitor with particularly aesthetic specimens of minerals from the mine. The king or prince displayed them to all who came to his home as visible evidence of his wealth. I call that collecting!

At this point in time, the average guy, including miners, had little chance to collect and keep such things as mineral specimens. Collecting—if we can call it that—was the exclusive province of the rich and famous. A term that best describes such collections is "princely collections"; I came across it while reading Wendell Wilson's "The History of Mineral Collections" in the November-December 1994 issue of *Mineralogical Record*.

Wilson describes an underground visit by the Duke of Albrecht to his silver mine in Saxony, prompted by the discovery of a huge mass of silver in 1477. The silver was a solid block measuring about 4 meters by 1 meter by 2 meters. It weighed about 20 metric tons (about 44,000 pounds)! The duke was actually served lunch as he sat next to this mass of silver, using it as a table. He apparently was given pieces of the silver mass; as remarkable as it may seem, two

These are oil lamps used by miners in the silver mines of Germany, where purposeful mineral collecting first developed.

Alchemists like Hennig Brand were among those who collected minerals for scientific study.

pieces still exist in the Staatlickes Museum in Dresden, Germany. Obviously, the Duke of Albrecht was one of those "princely collectors."

In the 17th century's Age of Reason, scientists began to question the unknown while questing for truth through experimentation and study. Thus emerged the formal scientific study of the elements and the chemical nature of substances. We now call it chemistry, a major science that grew dramatically in the 1600s and 1700s.

During the Age of Enlightenment, scientific investigation led to the emergence of modern science. Previously, chemistry was in the hands of the alchemists, and though they made significant contributions to the science and some significant discoveries, their main goal was to discover the elixir of life, which was reputed to transform base metals like lead into gold!

Mineralogy as a separate science was an outgrowth of the study of the chemical nature of substances. To study matter through chemistry, many scientists studied specimens of natural minerals. By testing them, scientists accumulated a huge body of knowledge about their properties. These studies led to the discovery of dozens of chemical elements and, in 1855, the development by Dmitri Mendeleev of the modern Periodic Table of Elements, so called because the same properties of groups of elements periodically appear in related elements.

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Though scientists exchanged specimens and accumulated large collections, they were doing it for scientific investigation, not as a hobby. That's a far cry from what we consider mineral collecting today. So during those few centuries of the Renaissance, the scientific branch of mineral collecting was slowly forming.

In the 1700s and 1800s, the wealthy—some of them scientists—began to emulate the "princely collectors" by developing collections of stuffed birds, fossils, native artifacts, and even minerals. One of the unusual ways wealthy people had of displaying their mineral wealth was to build crystal-lined grottos in their garden or at some viewpoint on their estate. Philip Rashleigh, a famous collector in the late 1700s, had such a grotto on his estate, Menabilly, from which you could look out over a broad lawn down to the sea. In later years, the specimens in the grotto were pried loose and taken away.

Menabilly was the home of Philip Rashleigh, a leading mineral collector in Cornwall, England, in the late 1700s.

Rashleigh, a Member of Parliament and owner of vast estates in Cornwall, England, began assembling his collection in the last half of the 1700s. His interest in minerals was both scientific and personal. In his day, his collection was considered one of the finest representations of minerals from Cornwall. The fact that he lived within walking distance of some mines must have played a role in arousing his love of minerals. His amazing assemblage of superb Cornish minerals was complemented by fine minerals from other countries. He traded with scientists like Count de Bournon and bought specimens from miners and local dealers. Yes, there were mineral dealers in the 1700s, additional evidence of the emergence of mineral collecting as a hobby.

Fortunately, the Rashleigh collection has survived, though it did pass through several uncaring hands. Today, it is housed in the Royal Cornwall Museum in Truro, Cornwall. The museum bought most of the collection during the 20th century.

Another good example of a collector from the upper crust of society is Sir Arthur Russell. Russell was a student of mineralogy and a hobbyist who collected minerals where he could. What made his acquisition techniques special was his title. In the stratified society of England, it gave him ready admission to some of the estates of the older royalty and landed gentry, some of which were in decline. Many of these people owned collections, so when a collector died, Russell was uniquely positioned to know about and acquire the collection. He was able to buy some of them and add them to his collection, which is now housed in a special room at the British Museum of Natural History.

By the 1800s, more and more scientists and individuals were collecting minerals, and the compilation of the properties of minerals grew immensely. More and more people in the upper strata of society were collecting minerals. Those who had some means and who had accumulated an exceptional collection documented those collections in book or pamphlet form. The acquisition of fine minerals by landed and titled gentry persisted through the 1800s and even into the 1900s. By this time, scientists were publishing accurate and in-depth mineralogy texts. But these were for academic uses, not designed for the average person.

Georg Bauer, writing under the name Agricola in the early 1500s, wrote one of the earliest books to mention mineral collecting!

In the 1800s and early 1900s, the average man in the street was still struggling to earn a living. He worked 10 and 12 hours a day, including Saturdays. What chance did he have of even seeing fine minerals, never mind owning them? The science of mineralogy was not taught in grammar school, which was as far as most people went in their education, so most people were not even exposed to the beauty of minerals. How could they develop an interest in them?

All that began to change as scientists began writing about minerals and displaying them in public museums. This was necessary for no other reason than for storage and record keeping. Possessing several thousand specimens for study presented two problems: organizing the knowledge gained, and storing all those specimens with proper labels.

The union between scientific study and museums allowed these mineral collections to be stored, yet be accessible to the public. Putting minerals on display has two important effects. First, it gains public and financial support for the scientists and their museum. Second, it exposes the aesthetic beauty of minerals to the masses. Given the innate curiosity of humans, once minerals were displayed publicly, it became a foregone conclusion that people would develop an interest in and desire to own mineral specimens. It was this relationship that brought about the explosion of interest in the mineral hobby.

I can cite a personal example of the influence of mineral displays in museums. In 1935, my fifth-grade class took a field trip to the Yale Peabody Museum in New Haven, Connecticut. I was 10 years old, and that field trip introduced me to the beauty and intrigue of minerals. I am a mineral collector today because of that one museum visit. The effect on the general public would often be the same. With their interest piqued, some museum visitors made the simple leap from viewer to collector.

To organize the information they had gained through the study of minerals, scientists and educators soon began producing mineralogy textbooks. The most important and best-known textbook on mineralogy in the mid-19th century was James Dwight Dana's *A System of Mineralogy*, which appeared in 1837. Dana was a professor of mineralogy at Yale University, one of the leading institutions in the development of the science of mineralogy. Dana's work was so important and useful that the book, as a single volume, was repeatedly revised and enlarged until 1944. By that time, the accumulation of knowledge was so great the Dana book had to be divided into multiple volumes. Vol. I appeared in 1944;

Vol. II came out in 1951; Vol. III in 1962; and Vol. IV is currently available.

The Dana series was fine for the academic world, but it became unwieldy for hobbyists and amateur collectors. Revisions were slow in coming, and 17 were necessary between 1898 and 1955. That gives you an idea of how knowledge and interest in mineralogy expanded from the middle of the 19th century into the 20th century. These formal publications of mineralogy data were soon followed by small articles written for the amateur, and in 1927 the first mineral hobby magazine, *Rocks & Minerals*, was published.

Mineralogy literature came full circle as skilled writers began producing useful reference books for the hobby. The most popular was Dr. Fred Pough's *Field Guide to Gems and Minerals*, which appeared in the early 1950s. As an amateur collector and student, I bought Pough's book hot off the press. The text, having been revised a half-dozen times, is still useful and available today.

An interesting human trait that emerges when people are able to collect minerals just as the royals did is envy. Royals suffered from the same trait. What collector doesn't enjoy showing off his or her best specimen, be it highly valued or exceptionally rare? In some cases, specimens are shown off just to arouse the envy of those unable to own such a specimen. It seems to be a human trait to try to best your neighbor with at least one of your possessions, be it car, house, land, or collectible. Back when royals were the most important collectors, those in slightly lower social standing could achieve some degree of pleasure if they could own a specimen equal to or better than something owned by the local baron or king.

Envy is one of the human traits expressed by collectors that tarnishes our hobby even today. It often removes the scientific joy of collecting, replacing it with one of feigned superiority. The true collector gathers specimens for the aesthetic and scientific interest they hold, rather than to exceed a neighbor's prized possessions.

While envy has its negative side, it can also be a positive motivator. The search for and acquisition of something fascinating or unique, of scientific interest or of natural beauty is more than enough motivation for many. Luckily, the desire to preserve and admire a unique product of nature is also a natural trait many collectors possess.

Once mineral collecting was available to everyone, a market for all things related to minerals opened up. Groups with a common interest began to form. Earth science courses were added to college and high school curricula. Mineral collecting had arrived as a major facet of our lives!

In modern times, the Apache Indians of Arizona still mine peridot by hand.

Today, mineral collecting is challenged by other areas of interest and distraction: movies, television, sporting events, and so much more. The demands on our time just to make a decent living seem to be moving us back to those early days of minerals when only the wealthy could afford fine specimens. This has been exacerbated by the investment craze that has hit the hobby, turning it into something less enjoyable and creating more aggressive individual collectors. Only the collector with deep pockets can afford many of the more aesthetically beautiful specimens available today. Unfortunately, many of these "collectors" know little about what they are offered and are easily overcharged. There are dealers, some of them well known, who feast on this easy prey. Many of us can name quite wealthy people who got into the hobby, only to quit within a few years once they realize they are being victimized.

This brings up yet another question. Where is our hobby headed? For an answer, we might look at the coin and stamp hobbies, which accelerated due to investors outnumbering the collectors in the hobby. These hobbies suddenly crashed. Will that happen to the mineral collecting hobby? Only time will tell. I do know that those who know their minerals and apply their knowledge will remain true to the hobby and will continue to enjoy one of the greatest of hobbies anyone can enjoy—mineral collecting!

Shop Talk

by William A. Kappele

Build or Rebuild?

Maybe you are new to the lapidary hobby and are trying to decide whether to buy a new machine, buy a used machine and rebuild it, or build a machine from scratch. It is a dilemma, but here are a few questions to ask yourself before taking the plunge.

1. How fat is my wallet? Obviously, if you just sold your house in Beverly Hills and moved to a cabin outside of East Snowshoe, Montana, you can buy the best and be happy.

2. Should I build or rebuild? If you build your own machine using new parts, you will have a brand-new machine. If you have the skills and tools to do the job, this might just be the way to go. It will take time to locate all the parts and more time to get them all assembled, though. If you decide to buy an old machine and rebuild it, you must first consider just how many new parts you will need, how much they will cost, and not least, whether the parts are still available.

Let's assume that you have decided to build a machine from scratch. Your first step is to decide just what scratch you need. For the sake of discussion, let's say you want to build a cabbing machine with wheels on a horizontal arbor. This is a pretty straightforward job. The critical parts are all off-the-shelf items: arbors, pulleys, belts, motors and, of course, wheels are readily available. Things like the splash shield and the coolant system can be put together from a number of different materials and can be plain vanilla or extra fancy.

Probably the best way to proceed is to look carefully at the commercial machines you like and see how they are put together, then start gathering parts. Send for catalogs, scrounge through the shop or garage, and surf the Internet. Make it a labor of love, but don't expect to start grinding cabs the day after tomorrow.

Should you find a good deal on a used machine, you have a different set of problems to deal with. On saws and grinders, the parts that wear out are usually bearings. Unless the machine you found was used during the building of the pyramids, you may well be able to find a standard bearing that will fit. If the shaft is too large or too small, or if the outer diameter of the bearing is wrong, there are still fixes. If the outer race is too small, it can be shimmed, or a spacer can be machined. If the shaft is too small, it can be built up by welding and re-machined. If too large, it can be turned down.

The nastiest part of the job is crud removal. With very few exceptions, old machines are **dirty.** Start any project by disassembling anything that will disassemble. Soak, scrape, wire brush, hose, or sand blast it—in short, just do what you must to get back to the original metal. Sandblasting is the way to go for rust. If you don't have a commercial blaster in your area, try finding a headstone maker. They use sandblasting to carve the stones. You might even kill two birds with one stone. By the time you have your machine ready to go, you might be ready for a headstone, too!

Please feel free to contact me if you have a suggestion or comment about this or any of my Shop Talk columns. My e-mail is quappelle@cox.net, or write to me at 25231 Pericia Dr., Mission Viejo, CA 92691.

FIELD TRIP

Yellow Cat Area Gems

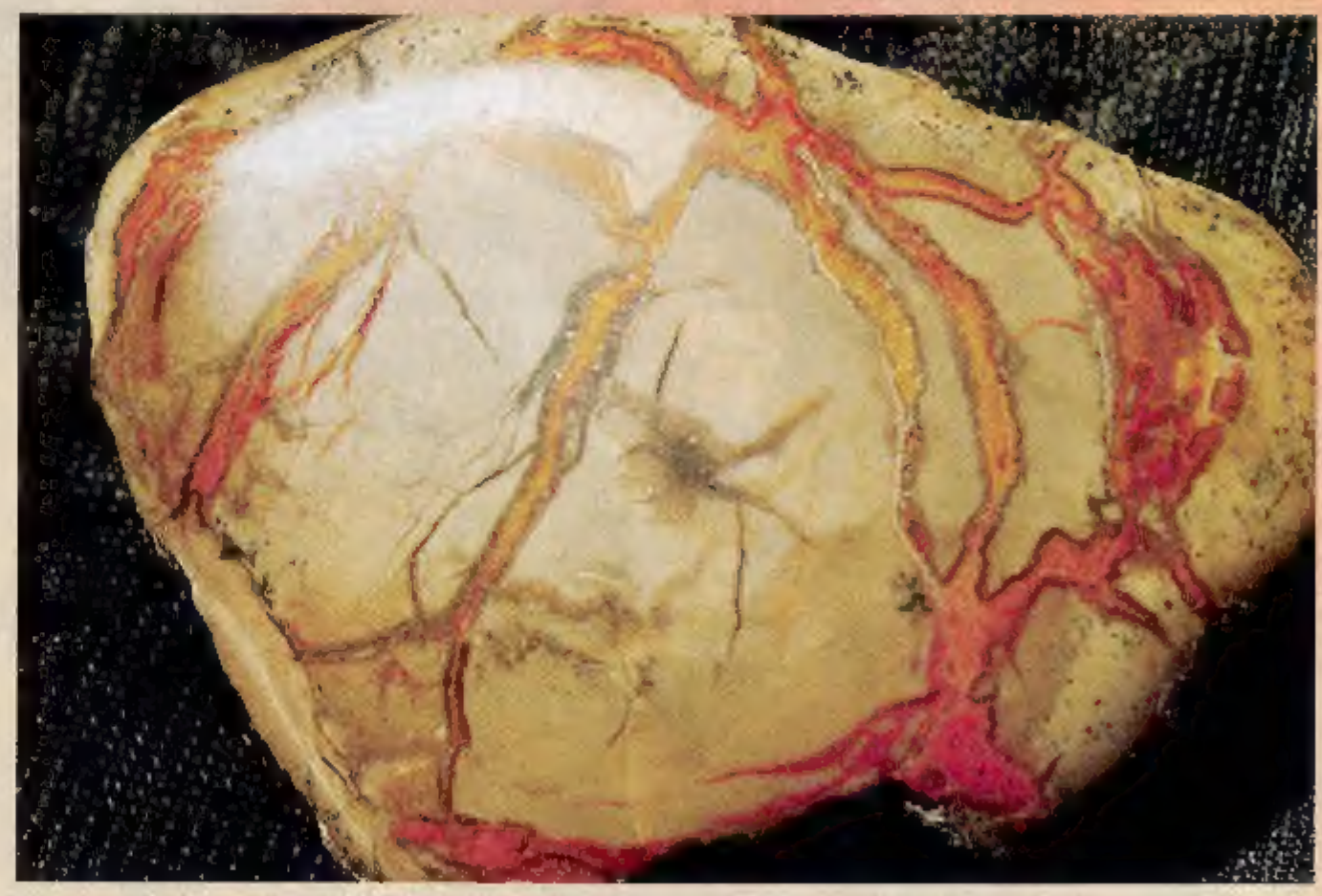
Pseudomorphs and Agate in Southeast Utah

Story and Photos by Gerhardt and Sandra Aldersea

Utah is a wonderful state for rockhounds, with many rock collecting sites. My husband, Gary, and I have two field guidebooks on Utah rock collecting and we had set out for the Cisco/Yellow Cat area, famous for its awesome petrified wood. The material has beautiful, red-banded agate around the outside, with different colors and patterns on the interior.

The guidebooks we consulted were *Gem Trails of Utah*, Expanded Revised Ed., by James R. Mitchell (Gem Guides Book Co., 1992), and *Rockhounding Utah*, by William A. Kappele (Falcon Press Publishing Co., 1996). Both books give excellent directions, and the site is very easy to find. From Grand Junction, Colorado, you take Interstate 70 west to Exit 193, take the dirt road south about 10 miles, and you are there. The spot is located between Green River, Utah, and Fruita, Colorado.

Gem Trails of Utah lists four collecting sites in the Yellow Cat area and says you can find rare pseudomorphs. *Rockhounding Utah* gives five collecting sites, but calls the finds barite balls, although they are basically the same thing. Neither book mentions the red petrified wood—maybe because it's almost impossible to find, so they don't want you to get your hopes up.



This specimen is typical of the "Jurassic art nodules" found in the Yellow Cat area.

After driving for six hours, we finally arrived in the Yellow Cat area, pulling our camper behind us. You know you've made it when you top the last rise and spread below you is a valley filled with the gray and maroon badlands of the Brushy Basin Member of the Morrison Formation. In the distance to the south, you can see the whitish sandstones of the Salt Wash Member of the Morrison Formation that cover the lower, flatter areas. The story I've heard is that the Yellow Cat area was named after a mountain lion that was killed by prospectors who were mining there during the 1950s and '60s.

The first thing you notice is tons of beautiful yellow, white and bright-red agate all over the ground. There's nothing like agate to get you excited, and this much agate definitely inspires you to high hopes! The second thing I noticed

is how beautiful the views are here, with the La Sal Mountain Range on the horizon looking so clear and blue with white snow on the top. What a beautiful place to rock hunt and be outside and be alive to enjoy all this!

Anxious to get started, I was about to take off with my bag to collect agate when Gary told me to look for pseudomorphs. "What's a pseudomorph look like?" I asked him. He said to look out for something with bumps on it. With that great information, I was off to walk the dry creek beds.

With beginner's rock luck, I found one after only about 20 minutes. I was almost positive I had found one because it's the weirdest rock I have ever seen. It's a black rock with little bumps and it looks just like deer droppings to me.

Pseudomorphs are formed when a mineral replaces another mineral, but still retains the crystal shape of the original mineral. Using this definition, then, the barite ball with an agate center would in fact be a pseudomorph. In this case, the barite has been partially or totally replaced by jasper and agate. Most of the balls still retain some barite on the outer regions, while the center is filled with banded agate and jasper. Some of the pseudomorphs have big, excellently formed crystals on the outside and are easily identified as a barite crystal structure that has been totally replaced by orange to red agate.

Occasionally, the center will have a drusy quartz filling. The fillings take many shapes, including those of a target with several rings, worms, and modern art. We have several that look like cave paintings of deer and one that looks exactly like a frog! In rare instances, you may also find a piece of shale peppered with small, agatized gastropods that have been replaced with red agate.

We searched for Yellow Cat petrified wood for over 10 years before collecting these pieces in 2006.

The Yellow Cat pseudomorphs are from the Jurassic Period and occur in the Brushy Basin Member of the Morrison Formation. The pseudomorphs appear to be most prolific in the Brushy Basin Member, where the outcrops are anywhere from a few feet to several acres in area. The surrounding hillsides have purple, gray and green dirt and shale, which is so typical of this time period.

Once you find a pseudomorph and you know what you are looking for, you will definitely find more. A good place to start looking is at the bases of hills, where they fall as they weather out. Agate collectors will love this area, as the ground is littered with them.

We also found a different crystal shape that we think is possibly a calcite pseudomorph or gypsum pseudomorph. It's definitely different than the barite crystal, but has the same beautiful, banded, red, white and purple agate in the center. At first, we thought it might be wood. Upon closer inspection with a magnifying glass, we couldn't see any wood structure, but we could see the weird, flat crystal structure on the outside. These specimens are not plentiful, but we have found enough of them to compare. I'm sure some people would gladly call the material red petrified wood because it's very similar, but upon closer inspection, you can see the different crystal shape on the exterior.

We have cut and polished a few pieces and they are gorgeous. Some of the beautiful pieces we find are just agate with no outside shape to identify it. It could be the red wood or a broken pseudomorph or this new crystal we are finding. What ever they are, they are gorgeous!

There is some black petrified wood, but it's scarce and is usually only found in the dry creek beds after the rain washes the new wood out. The black petrified wood is agatized and some pieces have lines of blue or red agate running through them. You can also find some white agatized wood that is float from the overlying Cretaceous sediment. These are almost always small, broken pieces, with wood grain only visible on one or two sides.

The wood here is very scattered and is mostly broken pieces, while on occasion a whole round may also be found. The Yellow Cat area petrified wood is only found in scattered areas within the Brushy Basin Member. I don't know if it only collected in certain parts of the river channel, such as bends in the river or flat areas that allowed the wood to sink and be quickly covered by sediments. It might also be that only certain areas had the right combination of quick burial and minerals in the groundwater to petrify the wood.

continued on next page

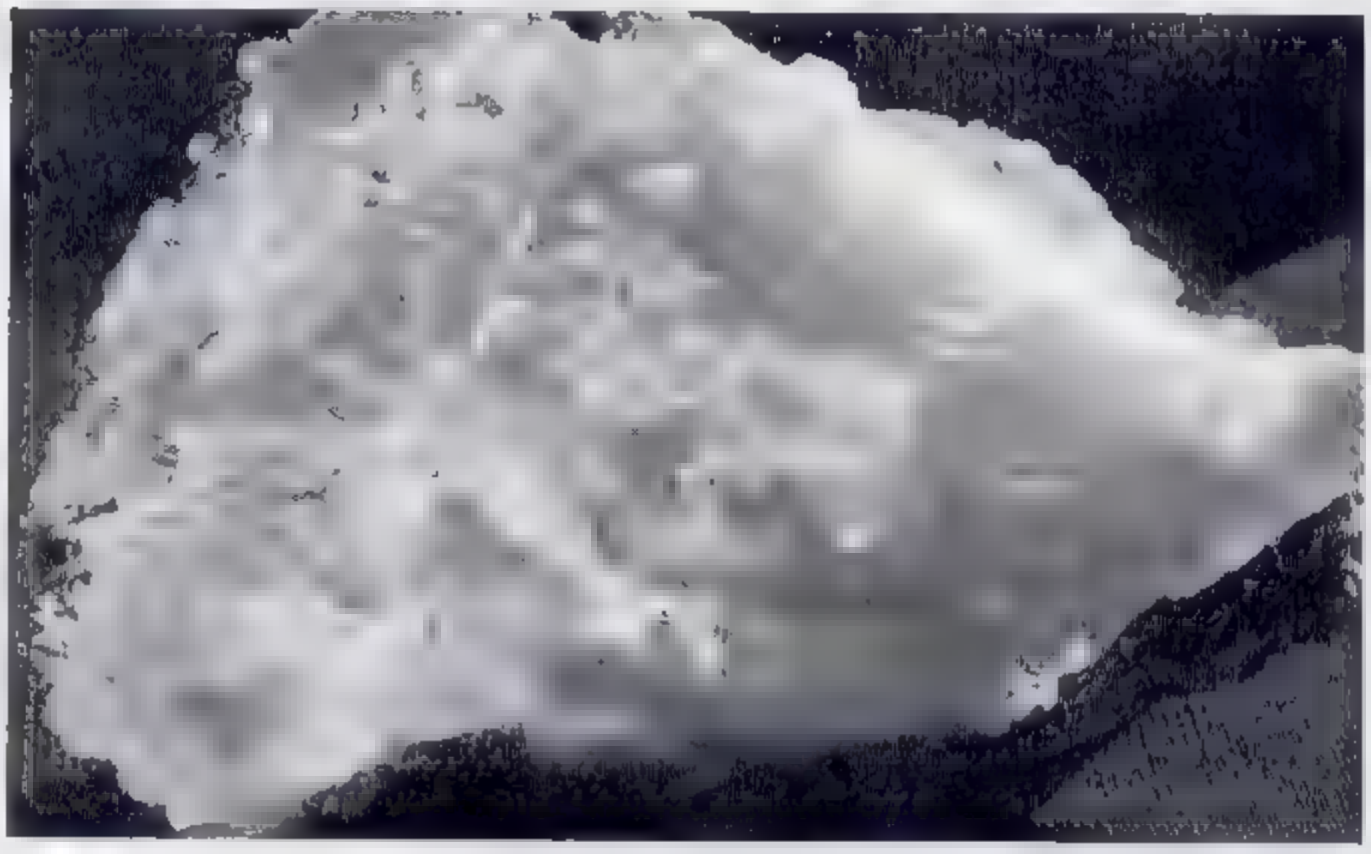
The deep lavender agate surrounded by red fortification agate in this pseudomorph is similar to the famous Yellow Cat petrified wood.

Yellow Cat Area Gems *from page 21*

In the many years we have hunted in the Yellow Cat area, we did find a very weird and unusual piece of the red wood that weighed 2½ pounds. It has the beautiful red exterior and irregular brown and green bands on the inside. Since we first decided to write about the area, we have actually discovered an outcrop that contained six small limb sections of the famous Yellow Cat red wood. The largest is 5½ inches long and about 3½ inches in diameter. They were located in the gray shale, with a little bit of conglomerate on the upper part of this layer. Needless to say, this is one of the most exciting finds of our collecting trips. All the pieces were encased in the gray shale and had to be soaked in water to remove it. They are all a deep orange-red, with tight fortifications.

The one thing we've learned is, just because a guidebook or article says that certain specimens are no longer found, it does not always turn out to be true. If you study the area and use a little detective work, you can sometimes find things that were assumed to no longer be available.

Another rock to collect is the "Jurassic art nodule." These are jasper and agate nodules filled with awesome colors and patterns. Each one is unique. We call them a "prehistoric snapshot" because of the time period they come from and because they just look ancient. Some of them have the striking red agate with the same red banding as the red wood. They are fairly easy to find and are all sizes, some up to 3 pounds. The smaller ones look like a cluster of chocolate-covered peanuts and usually have a smooth, black desert varnish on the outside.



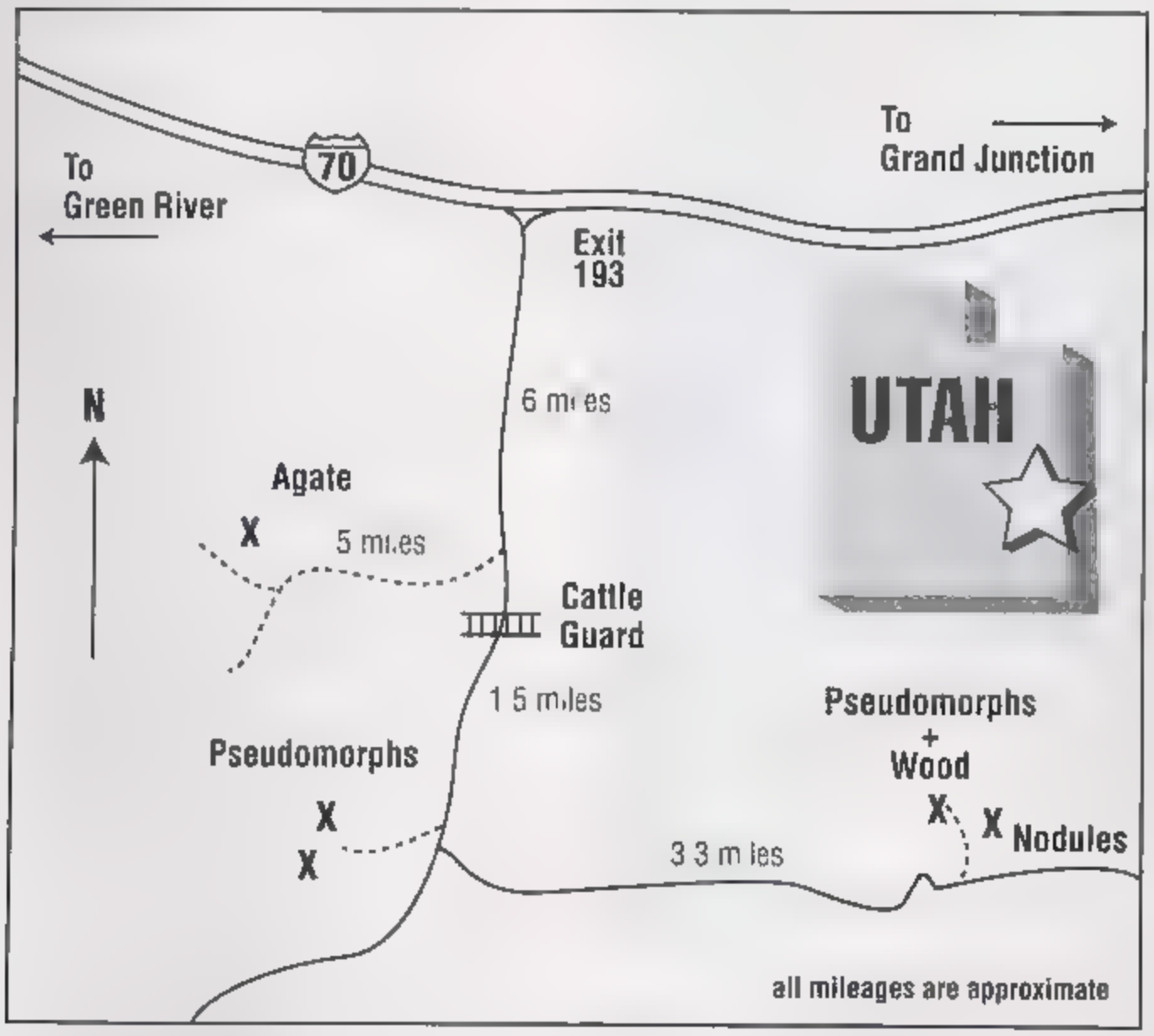
This pseudomorph contains red, white, yellow, lavender and green agate.

It seems odd to me, but I have not seen the Yellow Cat pseudomorphs in any books or for sale at rock shows, even at the annual Grand Junction, Colorado, rock show in May. You can't really tell what's inside your pseudomorph until you get home and cut it, but looking around at all the broken ones, you get an idea.

A large percentage of the pseudomorphs you cut open will have agate inside, and some will have crystals radiating to the edges. The ones with red blades on the exterior are the true pseudomorphs. These make excellent display specimens without even being cut open. The most abundant ones, however, are gray or black on the exterior and need to be cut to show the agate replacing the barite. I call these "pseudo-pseudomorphs," as they are a combination of barite and agate. Each one is different, and it is exciting to cut them open and see what's inside.

The bright-red-banded agate pseudomorphs are the best specimens. Different areas have different colored pseudomorphs, so be sure to collect some from more than one spot. They also make outstanding display specimens when left natural.

Once we get our treasures back home, we can't wait to cut and polish them. We have three diamond saws: 8-inch, 16-inch and 24-inch, which we inherited from my father, who got me started in the hobby. We most often use the 16-inch saw to cut the nodules and pseudomorphs. Then we use the Genie grinding unit to polish them. We don't use the round wheels to polish, but the pad pads, and we use six different diamond pads. We usually start with the 100 metal pad to get the saw marks out, then move on to the 280, 400, 600, 1200 and 14000 pads. For the bigger pseudomorphs, we use the 4-inch wet grinder, which comes with 15 different diamond pads and really gives a good polish. Both of the polishing units deliver an amazing liquid polish. It's so satisfying to see the finished rock. Seeing what the Earth and God have created, the excite-



ment of finding your special treasure, and being the first person to ever lay eyes upon it are what make us rockhounds keep going back again and again.

About five years ago, we were lucky enough to get my job transferred closer to our favorite rock collecting site. Our daughter and her family also recently moved near to us, and our two granddaughters are now little rockhounds. The Yellow Cat area is a great collecting spot for children because of all the agate that is easily found on the surface. They have a lot of fun collecting. Children and sometimes adults will get bored very quickly if they can't find any rock treasures, but that's not a problem here. We're also collecting priceless memories!

If you are planning on camping here, there are a few nice flat spots to park your camper or RV on. If you want to have a fire at night, bring your own wood, as there is none to collect in this area. The perfect time to visit is in the spring or fall when the weather is cooler. The desert gets way too hot in the summertime. As in most deserts, you need to keep an eye out for rattlesnakes. We have only seen one, but we have heard others say they are there. The insects are only bad in the spring, when there are areas that are loaded with gnats, so if you go at this time of year, be sure to bring bug repellent.

It's been about 13 years since our first trip to the Yellow Cat area, and we now have quite a collection of pseudomorphs and Jurassic art nodules. We have found a few pseudomorphs that weigh a whopping 10 pounds filled with a large area of red, white and purple banded agate and large barite blades on the exterior that are absolutely stunning! Even though we have found a few pieces of the famous Yellow Cat petrified wood, it took us many years to find it and we may never find another piece again. We will, of course, keep looking for the wood, but it's so much more exciting to actually find something.

Once you find your first pseudomorph with the awesome red-banded agate, you will definitely see why collectors want the petrified wood. The Yellow Cat pseudomorphs are mostly unheard of now, but hopefully not for long. This is such an excellent collecting site and you definitely won't be disappointed if you go here. There are abundant pseudomorphs, agates, Jurassic art nodules, and the new gypsum or calcite pseudomorphs, with a scattering of petrified wood. The surrounding mountains and scenery are so beautiful it makes this an extra special place to visit.

"THE FRUGAL COLLECTOR"

THE ZEOLITES

Part I: Stilbite, Stellerite and Analcime

• Story and Photos by Bob Jones

The abundance of zeolite minerals these days should make every collector drool. Before and shortly after World War II, most zeolite minerals were locally collected, particularly in New Jersey and Oregon, where basalt and diabase formations were quarried for road gravel, trap rock, asphalt, concrete gravel, and so forth. Such quarries have often yielded fine zeolites like stilbite, heulandite and natrolite. Minerals closely related to the zeolites are almost always associated with these minerals. This includes minerals like prehnite and apophyllite, as well as calcite and quartz.

Not surprisingly, zeolites seldom got the attention they deserved except from collectors who lived near such quarries. This is often due to the lack of color in most zeolites. They simply did not attract or excite many collectors. Luckily, this attitude has changed.

Thanks to aggressive marketing and a stunning supply of very showy, spectacular zeolites and associated minerals, interest has picked up. This happened when the Deccan Plateau basalts and diabases of India began to yield huge quantities of some of the most spectacular zeolites and associated minerals ever found. Gradually, collectors became aware of this new source. Anyone going to a show now marvels at spectacular zeolites like long mesolite needle sprays decorated with green apophyllite crystals.

This delightful and classic bow-tie of stilbite on minor apophyllite and prehnite is typical of the better specimens from the Nasik area of India.

This lovely stilbite—or is it stellerite?—is stained by iron oxides.

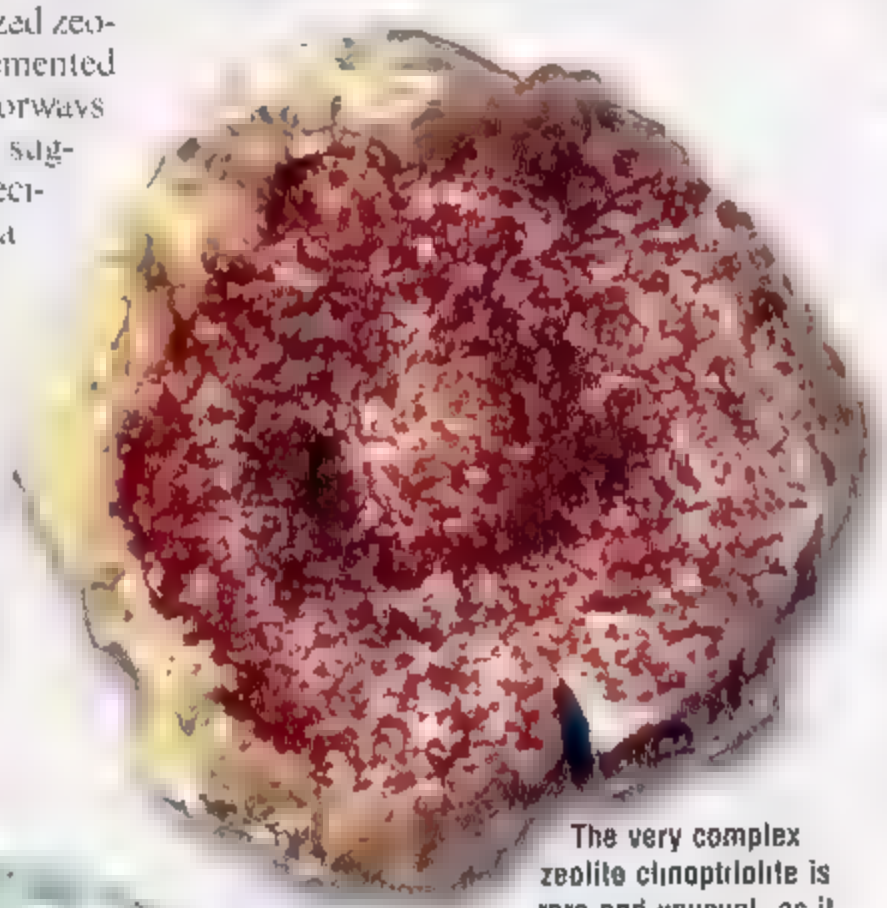
The plethora of showy species from India was discovered when volcanic rock was being quarried during India's explosive construction growth. During quarrying, vast numbers of mineral-bearing pockets were opened. Volcanic rocks are not the only source of zeolites. Since zeolites—stilbite being the best example—form at low temperatures, they are among the last minerals to form in pegmatite pockets. Consequently, they have a better opportunity to grow fine crystals. This accounts for the long, hairy crystals we see in natrolite, mesolite and the like. These late-forming specimens are really cherished because they are uncommon and almost always sit on something more exotic, like cubic zeolite crystals.

Collectors knew of Indian zeolites long before World War II, but production was minimal and few knowledgeable and interested people spent much time in India looking for zeolites. In fact, it was not unusual to find large, crystallized zeolites and associated minerals cemented into the walls and around the doorways of Indian miners' homes. That suggests the marketing of such specimens was not a means of making a living. Gradually, however, local collectors began to gather specimens for sale as foreign dealers began to visit this vast subcontinent more often.

As India developed at a rapid pace, the need for more roads and increased construction, coupled with an ever-increasing demand for concrete for use in the building industry, triggered the rapid increase in basalt or trap rock quarrying. Basalt outcrops located near burgeoning centers of population, such as Bombay, were opened and diligently worked, which opened up pocket after pocket of choice zeolites.

So what exactly are zeolites? Identification starts with the name, derived from the ancient word *zein* which means "to boil"! When you put a small bit of any zeolite in a test tube and heat it, water eventually boils out of the mineral and condenses on the cool inside walls of the test tube, in some cases quite readily.

Where does the water come from? Since heating the zeolite does not break it down completely, the water that is part of its chemistry is not released. Rather, most of the water that is released had been trapped within the crystal's structure, but not chemically attached to the mineral, during its development. It is this excess water that is released by heating.



MIKE GROBEN COLLECTION

The very complex zeolite clinoptilolite is rare and unusual, as it has a nice color.

This all relates to the internal structure of zeolites. They are made of frameworks of atoms that contain relatively large, open channels and cages that trap excess water molecules and, more importantly, excess metal atoms loosely within the open structure. The fact that metal ions can be trapped in a zeolite's structure is critical to a number of industrial processes and home uses for zeolites.

Ions of metallic elements are referred to as cations. A cation is the metal-element component of a chemical compound. In zeolites, these trapped excess cations, while technically not part of the zeolite mineral's chemistry, do perform functions critical to the world of chemistry.

The cations trapped in a zeolite mineral are electrically active. They readily attach themselves to any substance passing through the open spaces of the zeolite structure, and can therefore act as ion exchangers. As a solution passes through the zeolite, the excess metal ions in the zeolite will join to substances dissolved in the solution, forming an insoluble solvent. In effect, an exchange of ions takes place. The unwanted cations in the solution take their place in the zeolite. This process is very familiar to people whose local water supply contains dissolved metal compounds, usually a calcium compound, in what we call "hard" water. The metal compounds inhibit the water's ability to remove dirt.

Rain water, when collected directly from the sky, has not had a chance to absorb metal compounds from the ground, so it is considered "soft" water. Most water that has come into contact with the earth, however, contains all sorts of dissolved minerals. The "hardness" of the water varies according to the amount of minerals dissolved. Soap is less likely to be effective in hard water, as it does not lather easily, and it tends to leave a scum on clothing and dishes that is hard to rinse off. That good old ring in the bathtub is directly related to hard water.

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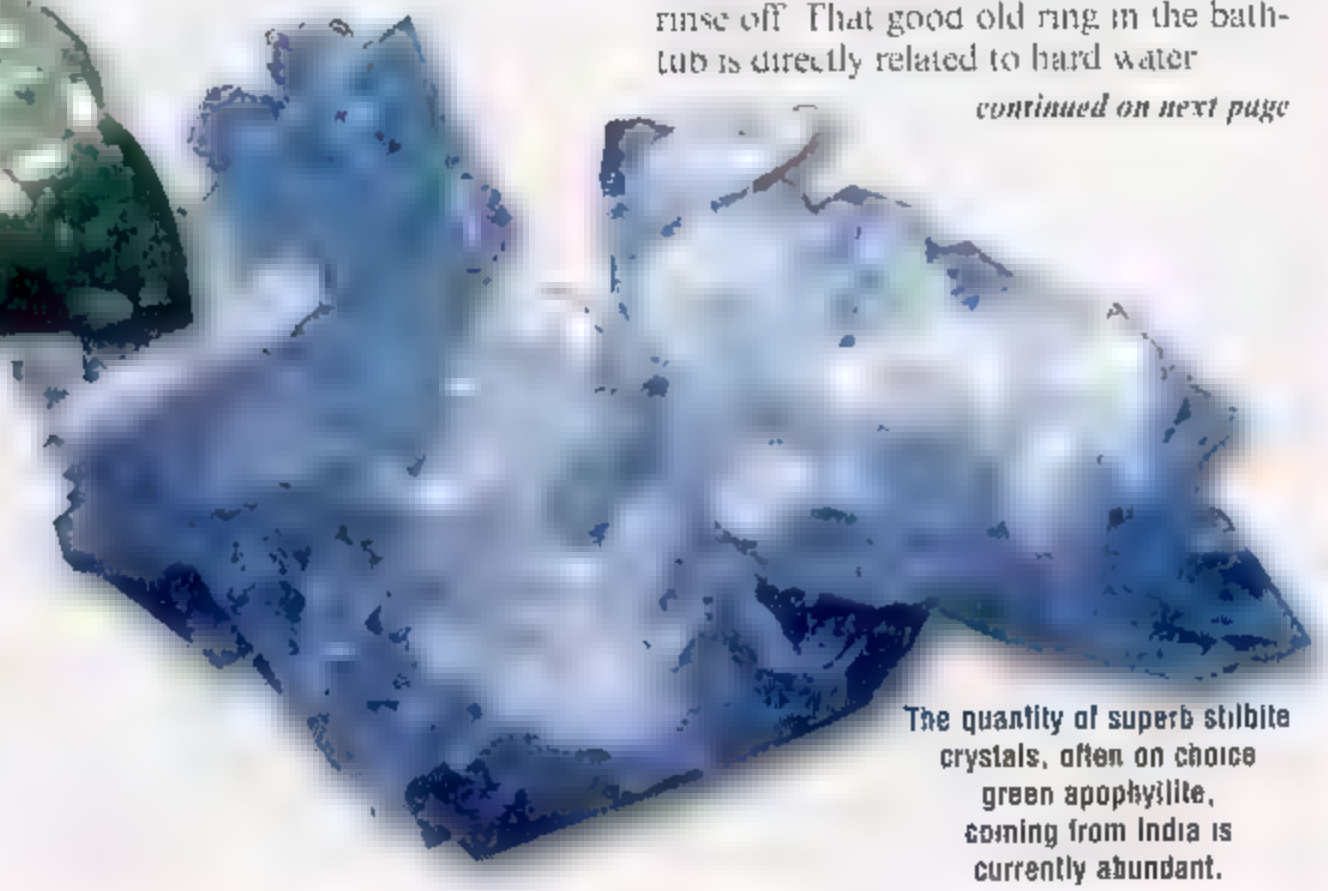
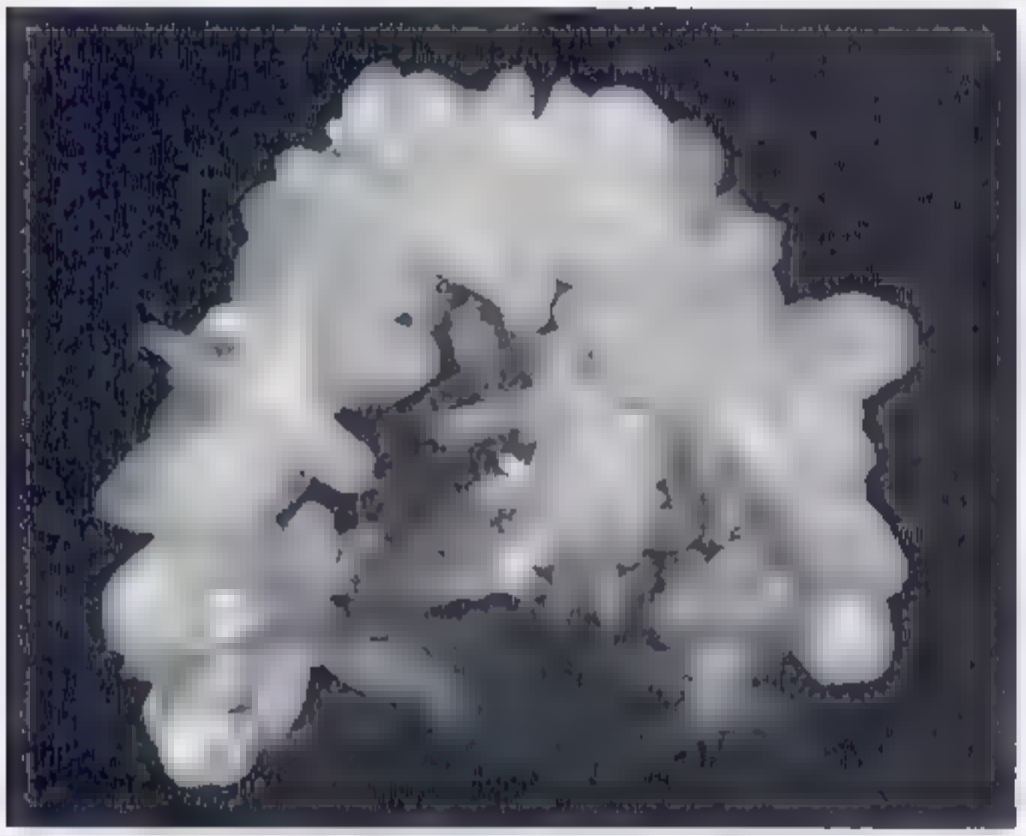
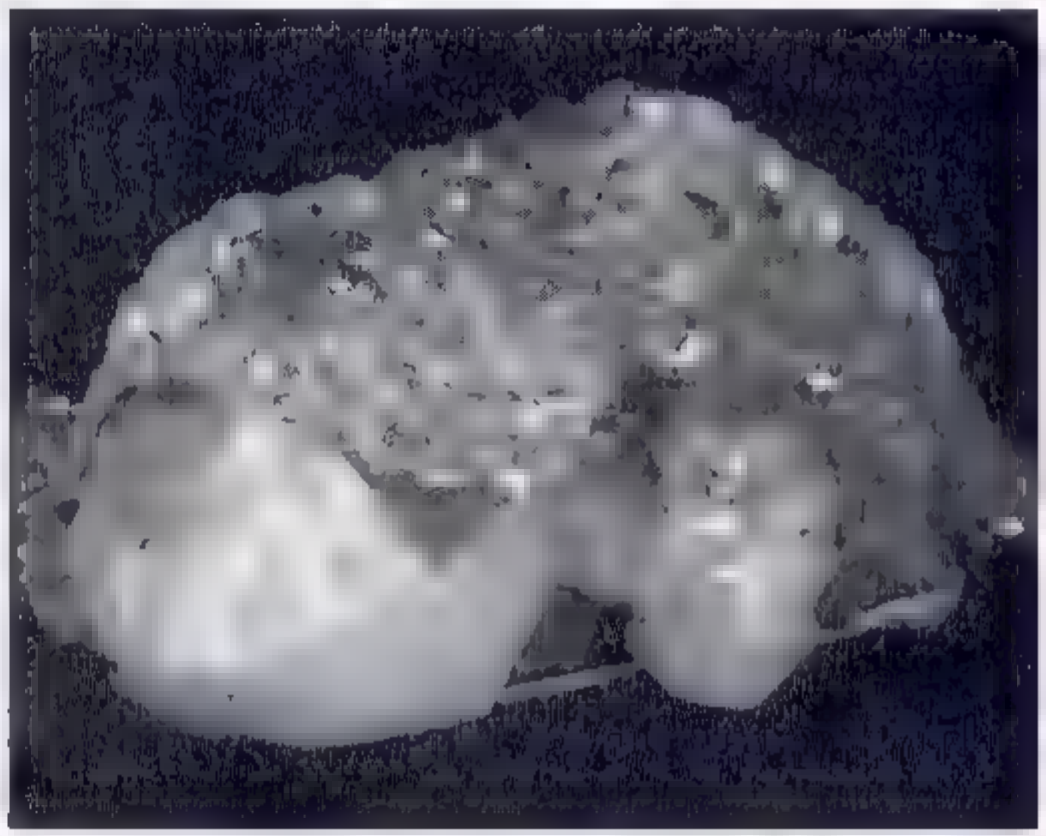
Choice green apophyllite with white stilbite is a very common association found in India.



The quantity of superb stilbite crystals, often on choice green apophyllite, coming from India is currently abundant.



It is not unusual for stilbite to form fine crystals on gem crystals—in this case elbaite—during the final stages of the formation of a pegmtitie pocket.



The classic copper deposits on Michigan's Upper Peninsula often produced choice anaclime crystals with apophyllite.

When hard water passes through a zeolite, the extra cations in the zeolite, most often sodium, exchange with the calcium ions in the water. The released calcium attaches itself to the zeolite. This exchange results in softer water.

This ion exchange creates a problem, though. If the calcium is left in the zeolite, the mineral loses its effectiveness. The calcium, or in some cases iron compounds, now in the zeolite has to be removed. The easiest way to remove the calcium is to run water through the zeolite that contains something more active than calcium, such as sodium.

This cleansing process is easily accomplished by dissolving salt in water and running the solution in a reverse flow through the zeolite. The sodium in salt, being more chemically active than the captured calcium, replaces this unwanted calcium. The zeolite is then ready to go again.

Zeolites also have other industrial uses, for example, as a catalyst. A catalyst is a chemical substance that promotes or accelerates a chemical reaction without being used up. You've heard of the catalytic converter in your car. The converter, which looks like a muffler, contains a chemical that breaks down some of the harmful hydrocarbons in the car's exhaust. The reason you don't have to replace the converter very often is that the platinum catalyst does not take part in the chemistry involved in cleaning your car's exhaust. In the same way, the zeolite only acts as a conveyor of active metal ions and is not part of the ion exchange.

You may think a water softener is full of lovely zeolite crystals. Have no fear; beautiful specimens are saved for more esoteric uses, like display. Zeolites like phillipsite are found in noncrystallized form as vast dry lakes in desert areas. These are mined for industrial uses like water softeners. Another common use for zeolites is as absorbents. The open structure of a zeolite makes it an ideal "receptacle" for some unwanted substances.

The chemical formula of some zeolites has an extra chemical symbol on its tail end. This indicates a significant amount of extra cation atoms trapped in them. For example, stilbite, a common zeolite, is often written stilbite-Ca or stilbite-Na to indicate the extra metallic element it holds. Chabazite can host three different elements, so it can be written as chabazite-Ca, chabazite-K or chabazite-Na. When you look at a chabazite specimen, can you distinguish the variety? Not a chance! We leave that to the scientists.

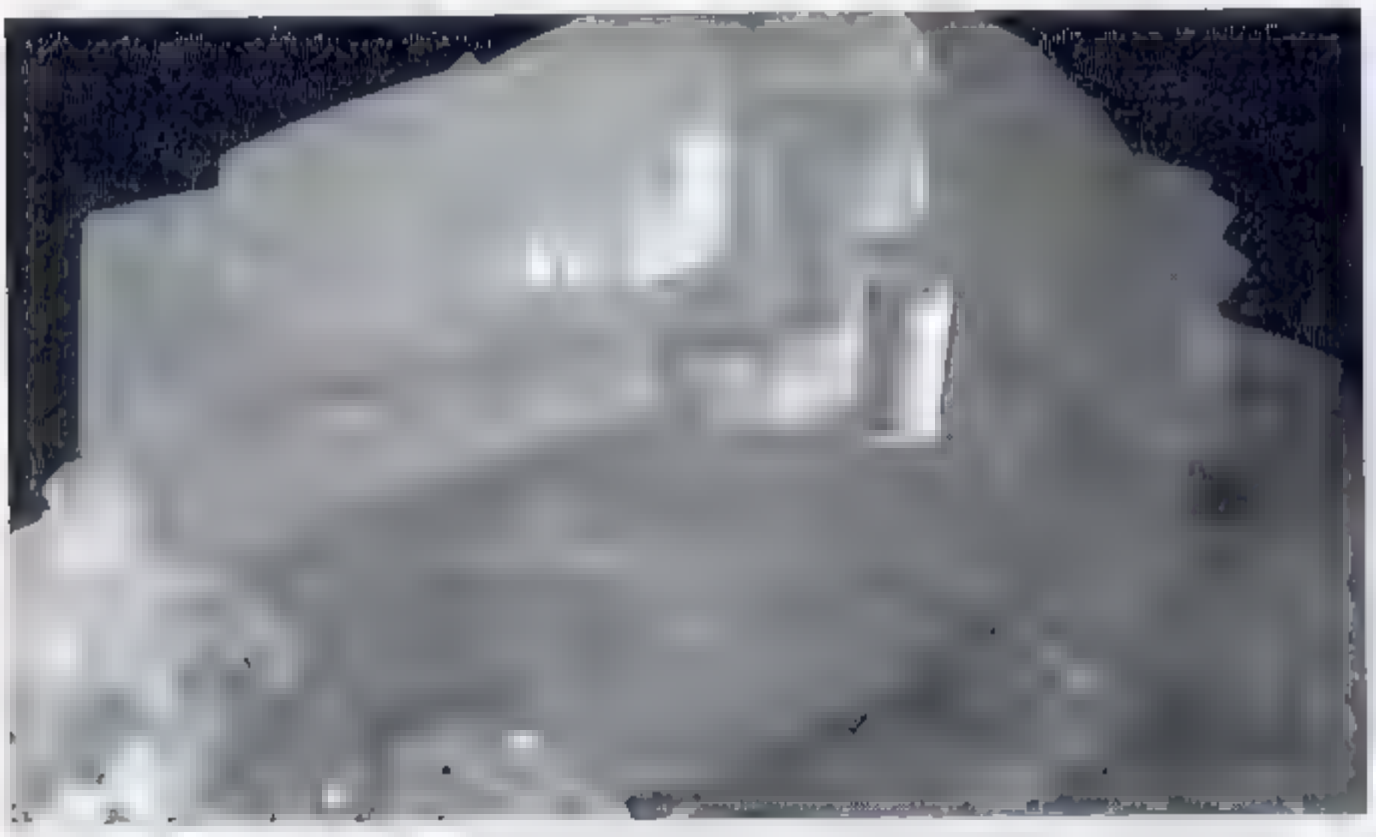
Counting these odd variations due to the extra metal ions, about 80 different zeolites have been identified so far. But of the 80 known species, maybe eight or 10 are really good collector species. Many zeolites were found only in one or two occurrences and only as microscopic crystals, so are almost impossible to collect. Others are simply unattractive. Only the really serious collectors and scientists collect the rare and unattractive members of any species.

The most popular and abundant of the zeolites are analcime, chabazite, gmelinite, harmotome, heulandite, mesolite, mordenite, natrolite, stilbite and scolecite. A few others, like okenite, have played an important role in raising public awareness of uses and properties of zeolites.

There are species that are frequently found associated with zeolites that collectors often think of as zeolites, though they are not. It makes sense to include them now simply because of their frequent association with zeolite members. These nonzeolite silicates include cavansite, datolite, pectolite and apophyllite. They are often very colorful.

Of all the zeolite minerals, stilbite is probably the most common and certainly one of the more easily identified members of the group. With its classic wheat-sheaf crystal grouping and susceptibility to iron staining, stilbite is easily spotted and can be quite attractive. But sight identification is always a chancy thing. The zeolite mineral stellerite shares many of stilbite's characteristics, and stilbite does not always form the classic wheat-sheaf crystal cluster.

Stilbite is usually found in snow-white to pale tan blades. One popular source has been the quarries around Paterson, New Jersey, where it occurred abundantly in gas or amygdule cavities with other zeolites. It shows a perfect cleavage and has a strong pearly luster on its cleavage face. Individual blades with a wheat-sheaf arrangement are curved, making them appear concave. These crystal clusters are also referred to as bow-tie groups; they are tightly pinched in the middle and the double terminations radiate out to form rather rounded ends. While the major faces are lustrous, the rounded ends are often fairly dull.



Neither apophyllite nor green prehnite are zeolites, but both are commonly found in zeolite environments. This rosetike apophyllite is 3 inches across and is from the find at Centreville, Virginia.

Iron staining can color stilbite pink, salmon or orange. Upon rare occasion it is green, due to inclusions of some other mineral. Though the vast abundance of stilbite comes from volcanic sources, it has been found as small, white groups in pegmatites, having formed on tourmaline or other minerals.

Stilbite was first given its name by Rene Just Haüy in 1801. "Stilbite" means "matter that has a true sudden bursting." This describes the mineral's sudden swelling action, when heated, to release boiling water. Stilbite was well known before 1801, having been found in fine groups around the volcanoes of Sicily and nearby islands. We seldom see specimens from Sicily these days.

America's East and West coasts have been prime sources of stilbite since the 1800s. The Upper and Lower New Street quarries, the Prospect Park Quarry, and other lesser-known quarries in the Paterson, New Jersey, area produced this zeolite, and during excavations for Interstate 80 through the Lower Jurassic formations, stilbite was collected abundantly. Unfortunately, due to rising insurance rates and the trespass of a few eager, but thoughtless, collectors, the eastern New Jersey quarries were almost all closed to collecting. Rumor has it that a little collecting still goes on when someone befriends a quarry watchman or gains surreptitious entry. Some collectors even lowered themselves by rope to collect at night. While this undoubtedly produced specimens, it also aggravated the situation and gave all collectors a bad name.

Some of the New Jersey stilbites were remarkable in size, with sheaves reaching over 4 inches in length and others forming crosslike penetration twins. While the quarries around Paterson get the biggest mention, so many quarries in New Jersey produced stilbite it is impossible to list them all. Any quarry that penetrates the volcanics of the area can be suspected to hold them. There are quarries at Bergen Hill and Great Notch, and in Union, Somerset and Mercer counties. Even railroad and road cuts and tunnels have, at times, been productive. A number of better-known modern collectors, including Dr. John Sinkankas and a man named Beatty who ended up as a major mining executive, got their start collecting the Jersey trap quarries. Much of my early collecting was in Connecticut's trap quarries.

Oregon is the other major source of stilbite and many other zeolite species. The vast Columbia Plateau, which covers portions of Washington, Oregon and Idaho, is made up of huge volcanic outflows in repeated layers, not unlike the Deccan Plateau of India. Zeolites occur abundantly in these vast lava flows.

Many Oregon quarries have yielded fine stilbites. Most are located near cities like Ritter Hot Springs, Spray, Eugene, Dollar and Goble. Most of the crystal groups found are small, but some span 2 inches or more. Most are white, often shading to cream. Not so common are pink to orange iron-stained crystals. Perhaps the most spectacular find in Oregon was a cavity that measured some 10 feet deep and was lined with stilbite in clusters that covered the floor and ceiling. This must have been an amazing sight.

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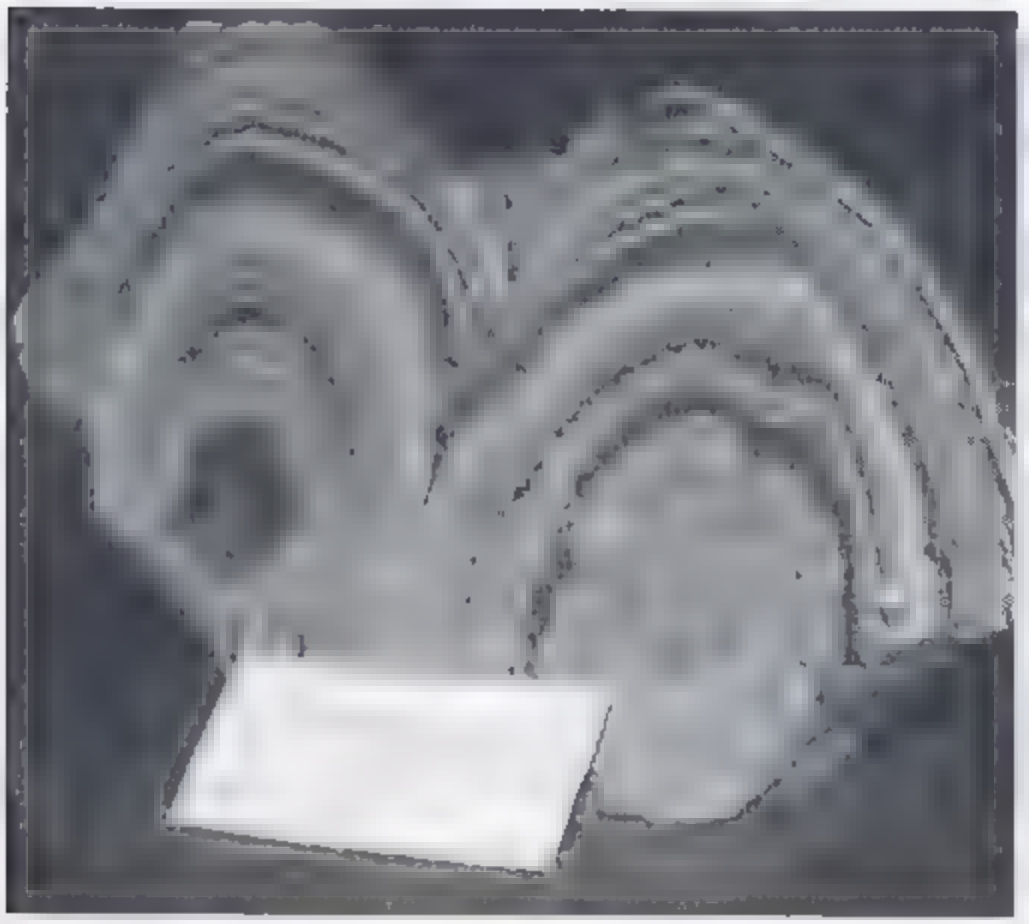
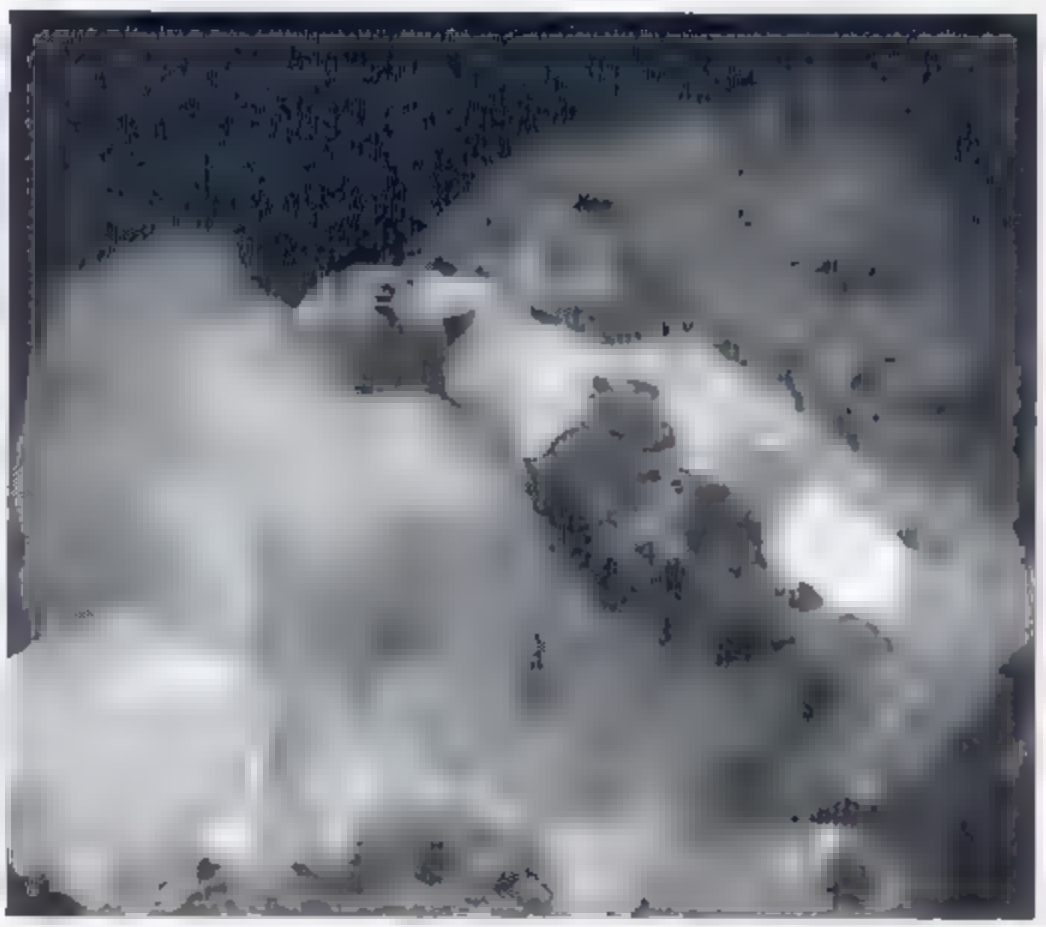


The white datolite in this odd mass from Siberia is associated with zeolites.



Stilbite is always a good mineral to collect, as it is attractive and common.

Oregon and New Jersey continue to supply small amounts of stilbite and other zeolites to collectors. These are supplemented by occurrences at Colorado's Table Mountain and small quarries in Connecticut. In fact, anywhere basalt, diabase, or other volcanic flow is found, one might expect to find evidence of zeolites.

Many of these earlier sources have dried up, but the supply of zeolite specimens is better than ever now thanks to the vast quantities that are offered for sale today from the active quarries of India. In the old days, most zeolites that came from India were simply labeled "Poona" or "Pune," a rather generic locality name. Today, so many quarries are producing and are being identified accurately that "Poona" is being exceeded by other productive site names.

The Nasik District, about 75 miles northeast of Bombay, is the leading source for stilbite. Here, superb snow-white cream, pink, salmon and orange bowties are found in great abundance. There are several quarries producing here, in which cavities can be 6 feet across or wider and yield crystals that can be 4 inches long. Other sources for stilbite in India are Lonavala, Japgaon and Wagholi quarries.

It is important to note here that the Deccan Plateau consists of two distinctly different types of lava in a whole series of flows, some of which are good pocket producers and some of which are not. The types of lava are called AA and Pahoehoe, terms originating in Hawaii. AA is tight, dense lava containing a very limited number of gas pockets. It flows rapidly, which tends to force out the trapped gasses. As a consequence, AA is not a prolific zeolite producer. Pahoehoe lava has a ropey appearance. This lava flows more slowly than AA and tends to fold over itself, making spaces in which gases accumulate. These pockets are later invaded by solutions from which crystals can grow.

Stilbite, a hydrous calcium, sodium, potassium, aluminum silicate, is easily confused with another zeolite, stellerite. This hydrous calcium aluminum silicate forms in wheat-sheaf crystal groups, just like stilbite! Stellerite is often white to cream in color, and can occur in the same environment as stilbite. When stellerite was first encountered on an island in the Bering Sea, it was thought to be a variety of stilbite. Its correct chemistry was not figured out until more than 100 years after stilbite was identified.

Like stilbite, stellerite can form in single crystals showing a pearly luster or in radiating spherules. It is impossible to visually distinguish between the two. One expert on Indian zeolites suggests it is wise to label a specimen thought to be one or the other "stilbite/stellerite." I call that hedging your bets!

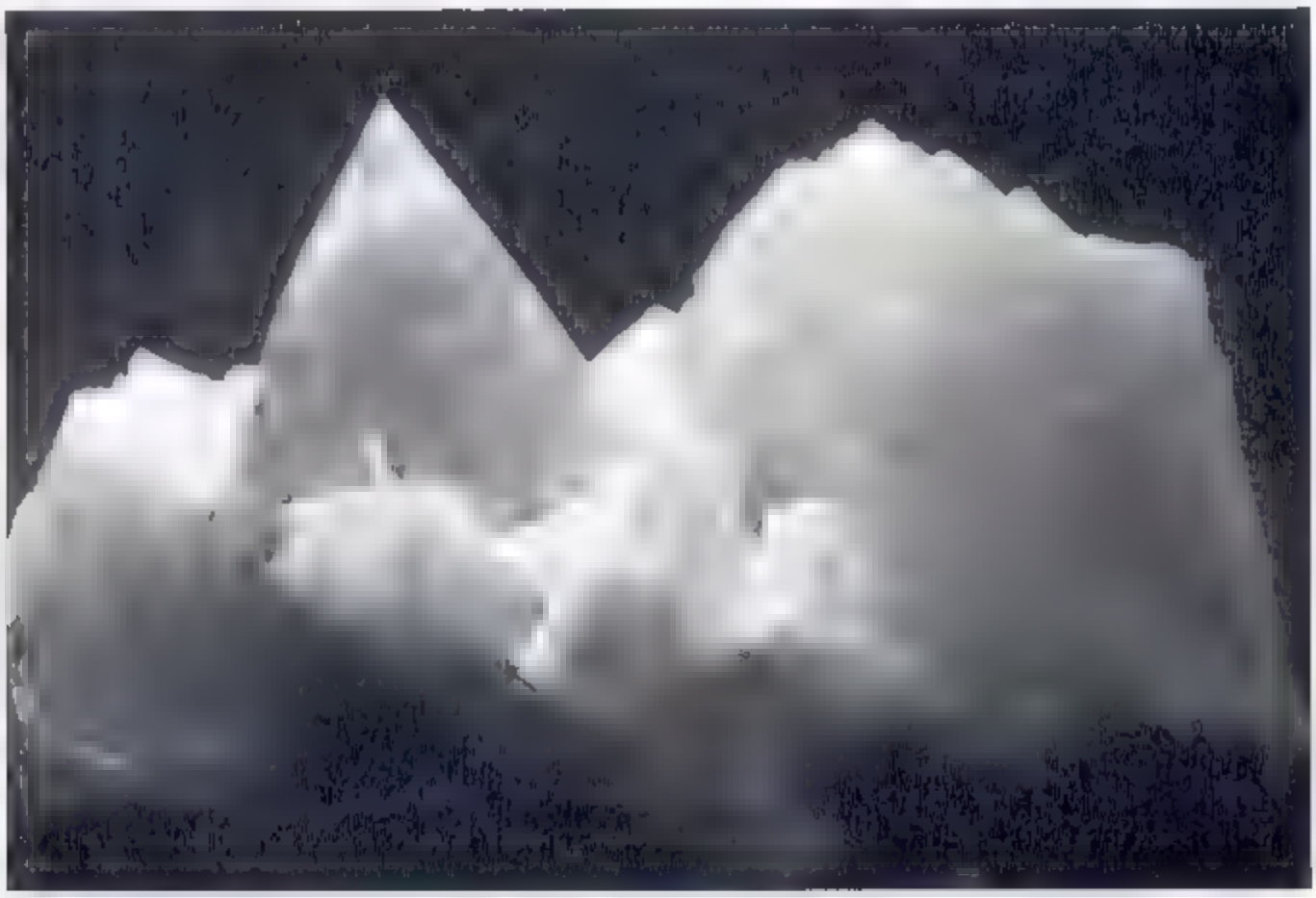
Far less common than stilbite is analcime, which is sometimes listed by its earlier name, analcite, in textbooks. This hydrous sodium aluminum silicate is uncommon in the quarries of India, where vast quantities of other zeolites are being mined. Luckily, it is found at two famous North American specimen localities we don't normally think of as zeolite-type deposits. One is the copper deposits of the Keweenaw Peninsula in Michigan's Upper Peninsula. The other is Mount St. Hilaire's Poudrette and DeMix quarries in Quebec, Canada.

The Michigan copper deposits are, in great part, volcanic in origin. Solutions apparently leached the native copper out of the volcanics and deposited it in basaltic and conglomeratic structures. The solutions were also zeolite-rich, so zeolites are readily found here as an accessory mineral associated with copper and silver. The analcime can occur here on native copper and, in a few cases, with native copper inclusions, suggesting they both formed at about the same time.

The white analcimes in Michigan can be an inch or more in size and show the typical complex trapezohedron form, which makes them look like white garnets! Included copper gives them a reddish look. Good examples are not common, which makes them eagerly sought by collectors.

The analcimes from the Mount St. Hilaire deposits are very attractive snow-white crystals, sometimes with black acmite needles sticking through them. The analcimes sitting along the prism faces of flesh-colored serandite make a very fine combination. These white, almost porcelaneous crystals can be as much as 2 inches across and also look like white garnets. When you consider the suite of fine nonzeolite minerals found at Mount St. Hilaire, the analcimes are an interesting addition.

Analcime occurs in many localities. Table Mountain, near Denver, has pro-



White stilbite from India sometimes has choice, sharp, yellow powellite crystals associated with it.

duced fine 2-inch crystals, and at Wasson's Bluff, Nova Scotia, it is found intimately associated with stilbite. Several quarries in New Jersey, mainly centered on Paterson, have yielded fine analcimes, as have some of the quarries in the Oregon trap rock deposits. Australia, Iceland and Scotland have also produced analcimes, the Scottish deposits produced crystals to 4 inches across! Specimens from these foreign deposits seldom reach America, some of them are no longer producing or yield only small numbers of specimens sporadically. The Kola Peninsula of Siberia has been producing analcimes recently, but distribution is hampered by factors such as distance and weather.

The volcanic region of Rio Grande do Sul, Brazil, is being diligently worked these days, but not for zeolites. Strenuous mining here extracts the world-renowned amethyst geodes that occur in basalts. These huge, curving masses of rock lined with purple amethyst crystal points have become exceedingly popular for interior decor. The amethyst "geodes" are seen in abundance at many shows. Some of the vugs are so large as to be tunnels lined with violet-colored quartz points. They sometimes host fine calcite crystals, long prisms of laumontite, and other zeolites. Analcime is sometimes found intermixed with the prisms of laumontite.

During the building of Skookumchuck Dam, near Tenino, Washington, fine analcimes were commonly found in gas cavities. In fact, the Columbian Plateau that covers much of Washington and Oregon is a sporadic source of analcime, depending on the amount of basalt and diabase being quarried at the time.

Paterson, New Jersey, was once the best place in America to dig analcime. Eastern collectors worked these quarries diligently for fine 1-inch crystals when specimen collecting was widely allowed.

Perhaps one of the reasons analcime is not as common as one might expect is that it can be very hard to identify. When it shows the classic trapezohedral shape, it is an easy mark, but analcime is sometimes called the "chameleon of the zeolites," as it can develop in no fewer than four of the six known crystal systems. Aside from its common trapezohedral shape, it has been found as pseudoorthorhombic, monoclinic and triclinic crystals. These differences in crystal form are controlled by the various metallic elements that can get into the analcime structure, including cesium and magnesium. In spite of that, when analcime is named in textbooks it is called "calcium-rich analcime."

While analcime is relatively uncommon and stilbite is the most common zeolite, the nonzeolite silicate apophyllite has to be one of the most attractive species to be found associated with zeolites.

With an abundance of zeolites now on the market, many of them some of the most attractive available in decades, zeolites are certainly a must for every collection now. Zeolites are a wonderful group of collector minerals because they are abundant, often very showy, readily obtained, and relatively inexpensive.

GOLD AND GEM HIGHWAYS

ROADSIDE PANNING SITES IN SOUTH CAROLINA

Part IV: Greenwood, Kershaw, Lancaster and McCormick Counties

Story and Maps
by David and Clois Walker

GREENWOOD COUNTY (MAP SC30)

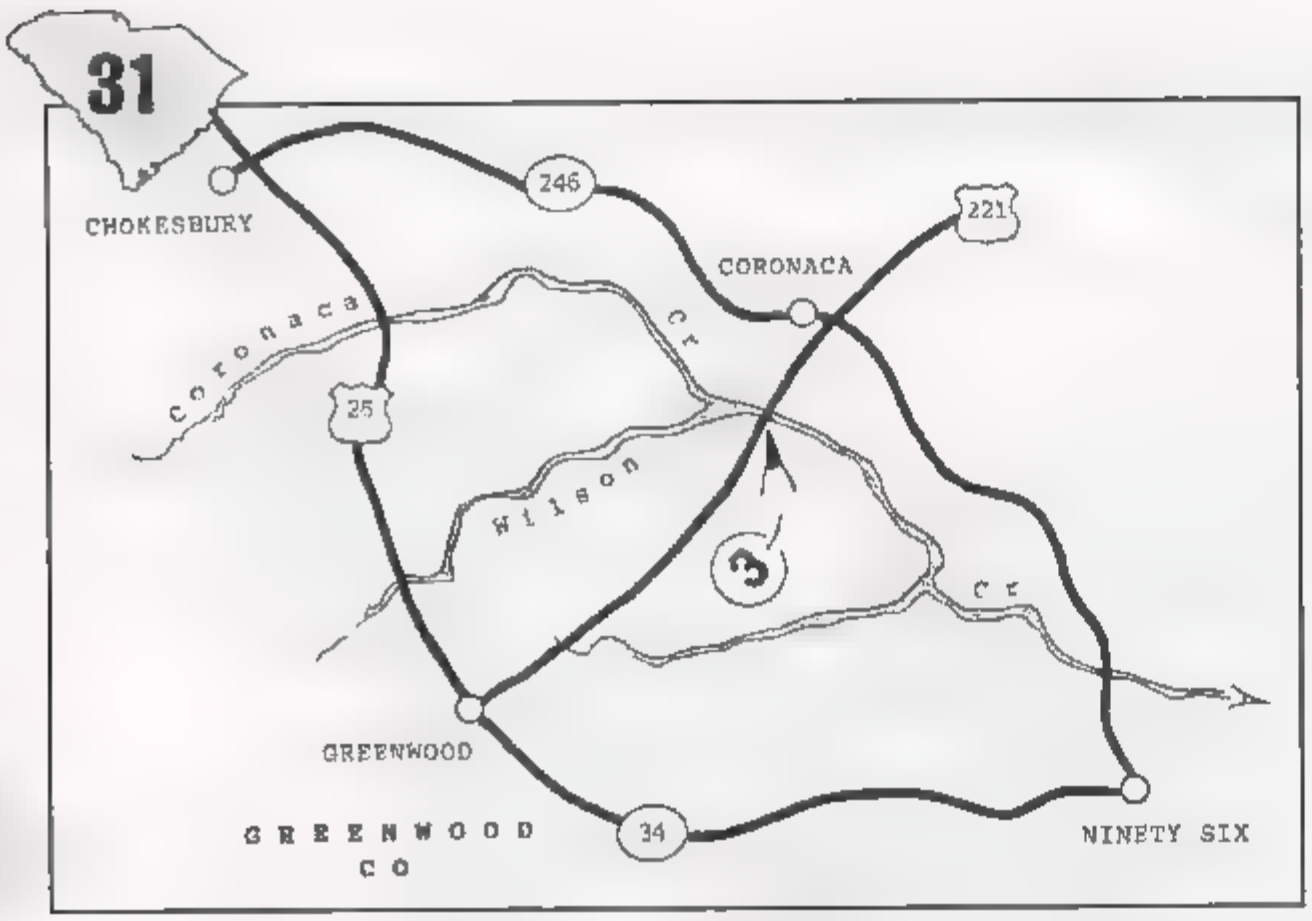
Site 1. **Saluda River/U.S. Highway 25** crossing near **Ware Shoals.** Vicinity finds indicate amethyst potential.

Site 2. **Goose Creek/U.S. Highway 25** crossing near **Ware Shoals.** Vicinity finds include amethyst and quartz.

This is the fourth in a series of six articles containing maps that indicate suggested panning and screening sites at South Carolina highway/stream crossings where appreciable finds have been previously reported in vicinity watersheds. The principles of erosion make it likely that minerals and gemstones have been deposited in river gravels, awaiting removal by a rockhound with a pan. This is a speculative study: whether conditions at these sites are conducive to panning activities and whether minerals can indeed be found have not been investigated.

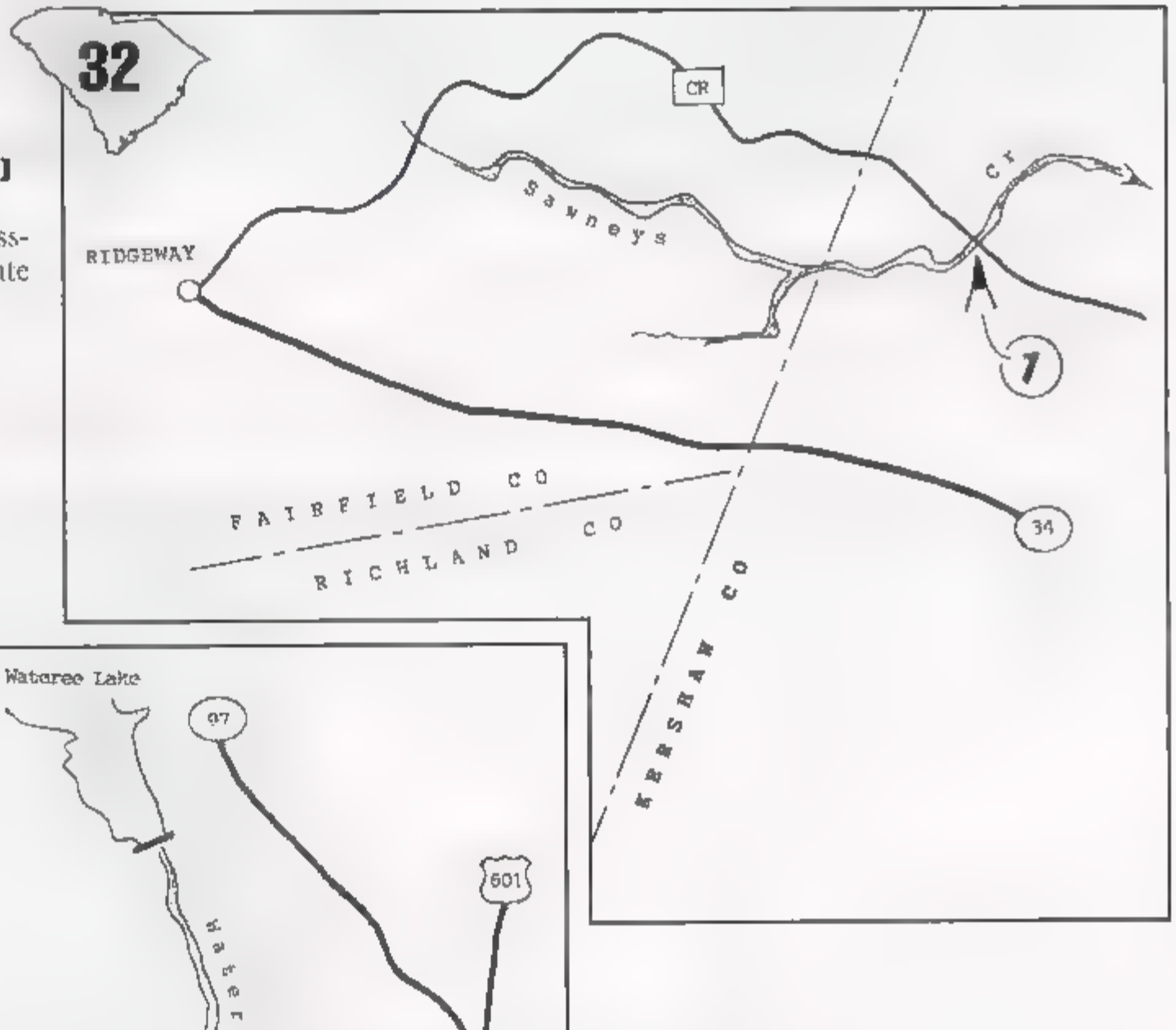
By confining operations within government-purchased highway rights of way, panners are spared the necessity of locating and obtaining permission from adjoining property owners. However, government permission is given on a case-by-case basis. Visit the South Carolina Department of Transportation Web site, www.scdot.org/inside/engineering_directory.shtml to find the number of the local office that gives access permission and explains the extent of the right of way. Readers also run the risk of prosecution if they cross onto private land, whether purposely or inadvertently.

Remember to observe highway safety and environmental standards, such as parking only where designated, and using only a pan and scoop. The maps provided contain the most up-to-date information available to us, but it is advisable to consult a current state highway or county map when planning an outing, for overall orientation in the field and because highway designations have been known to change.



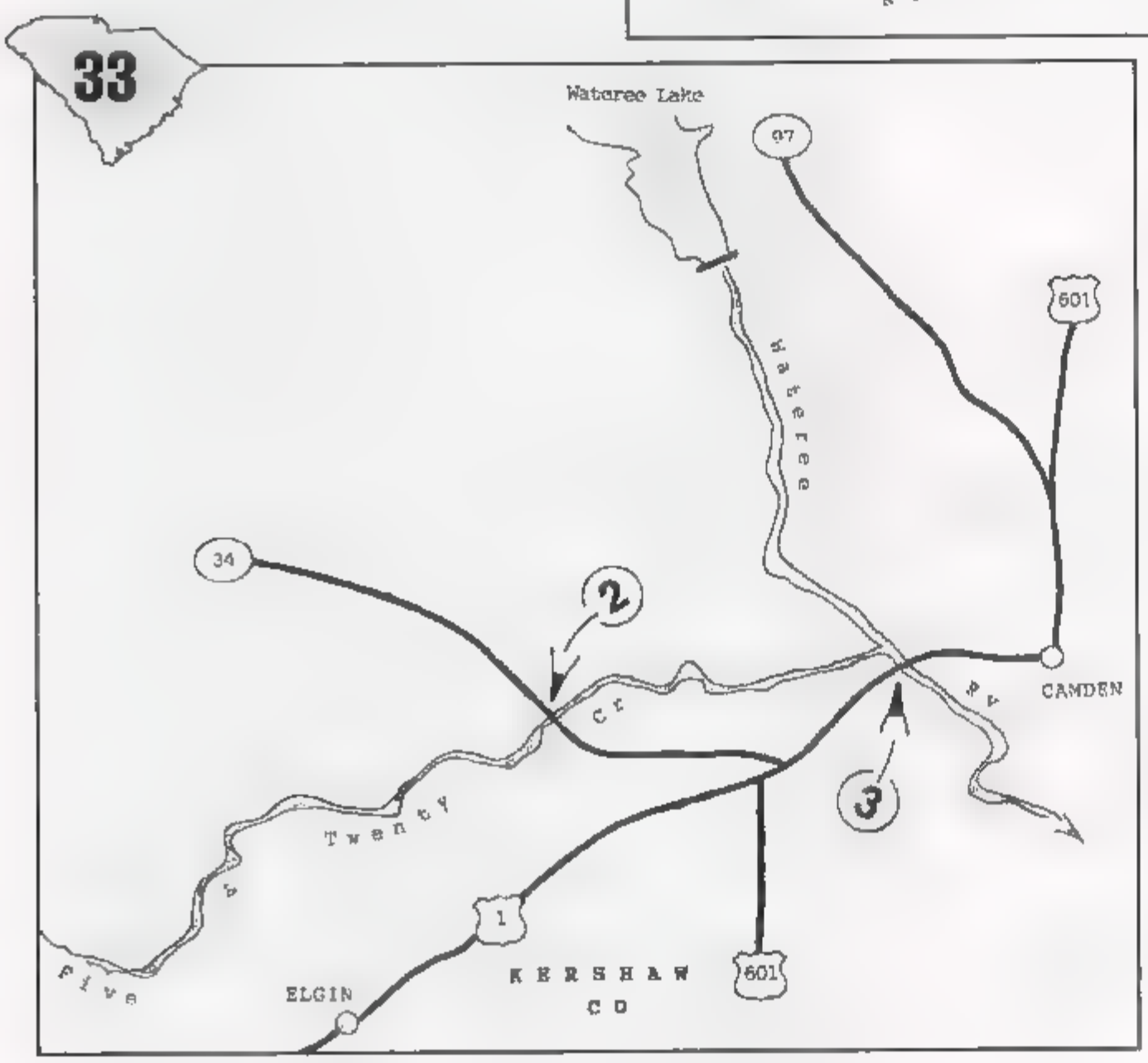
GREENWOOD COUNTY (MAP SC31)

Site 3 **Coronaca Creek/U.S. Highway 221** crossing near **Greenwood.** Vicinity finds indicate gold potential



KERSHAW COUNTY (MAP SC32)

Site 1. **Sawneys Creek/County Road** crossing near **Ridgeway.** Vicinity finds indicate gold potential.



KERSHAW COUNTY (MAP SC33)

Site 2. **Five and Twenty Creek/state Route 34** crossing near **Camden.** Vicinity finds indicate gold potential

Site 3. **Wateree River/U.S. Highway 1** crossing near **Camden.** Vicinity finds indicate gold potential.

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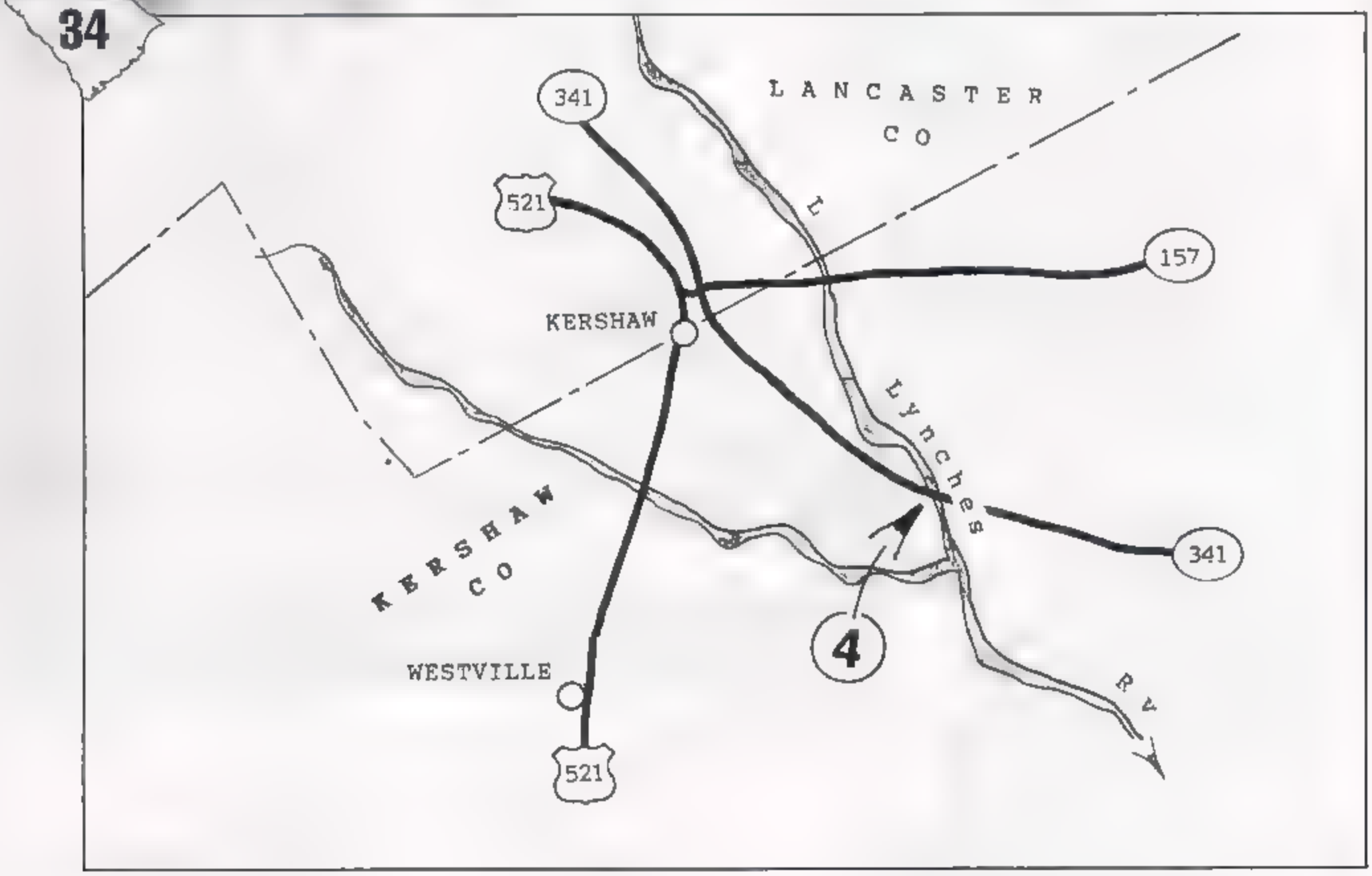
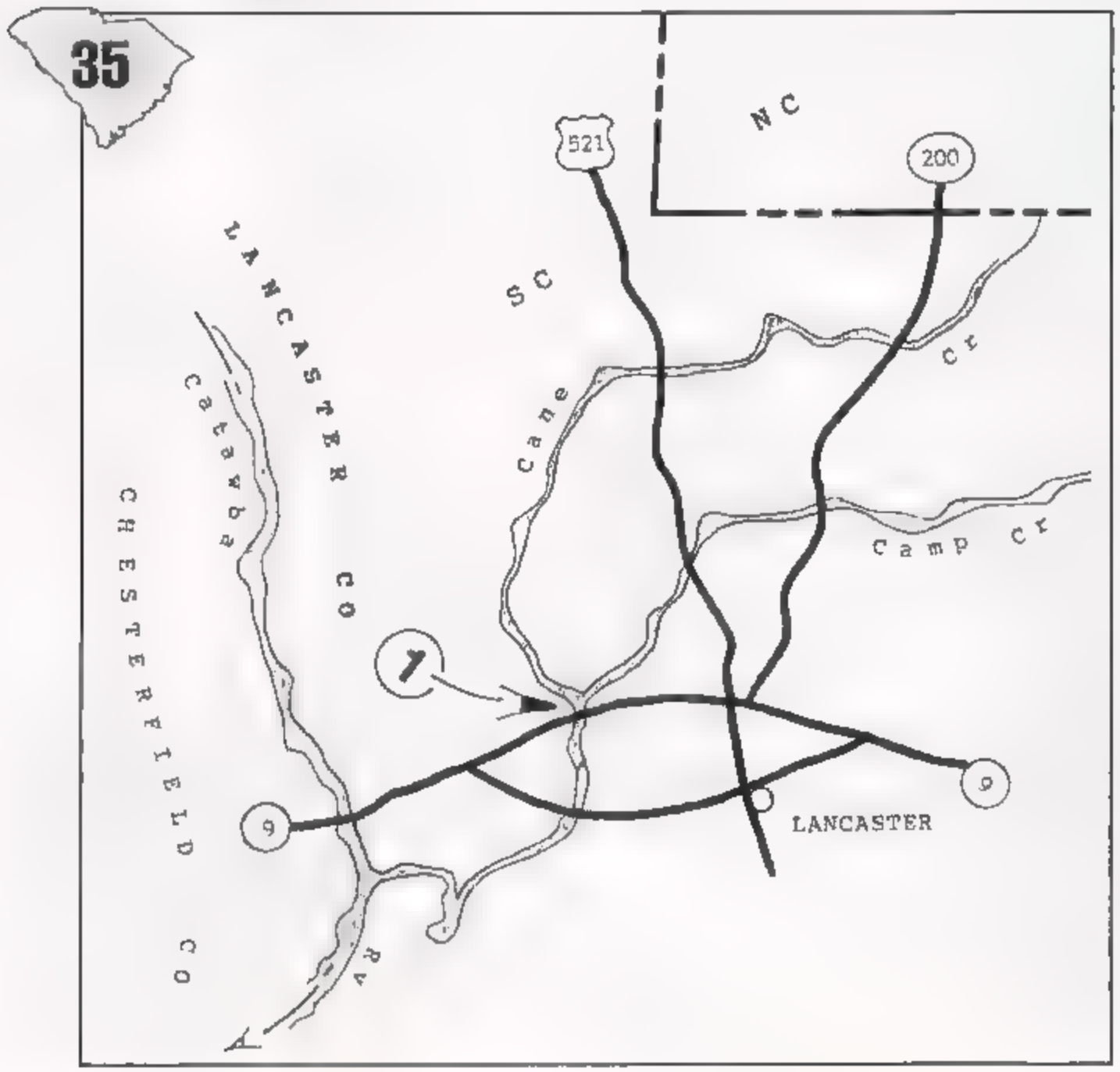


KERSHAW COUNTY (MAP SC34)

Site 4. **Lynches River/state Route 341** crossing near **Kershaw.** Vicinity finds indicate gold potential.



LANCASTER COUNTY (MAP SC35)

Site 1. **Camp Creek/state Route 9** crossing near **Lancaster.** Vicinity finds indicate gold potential

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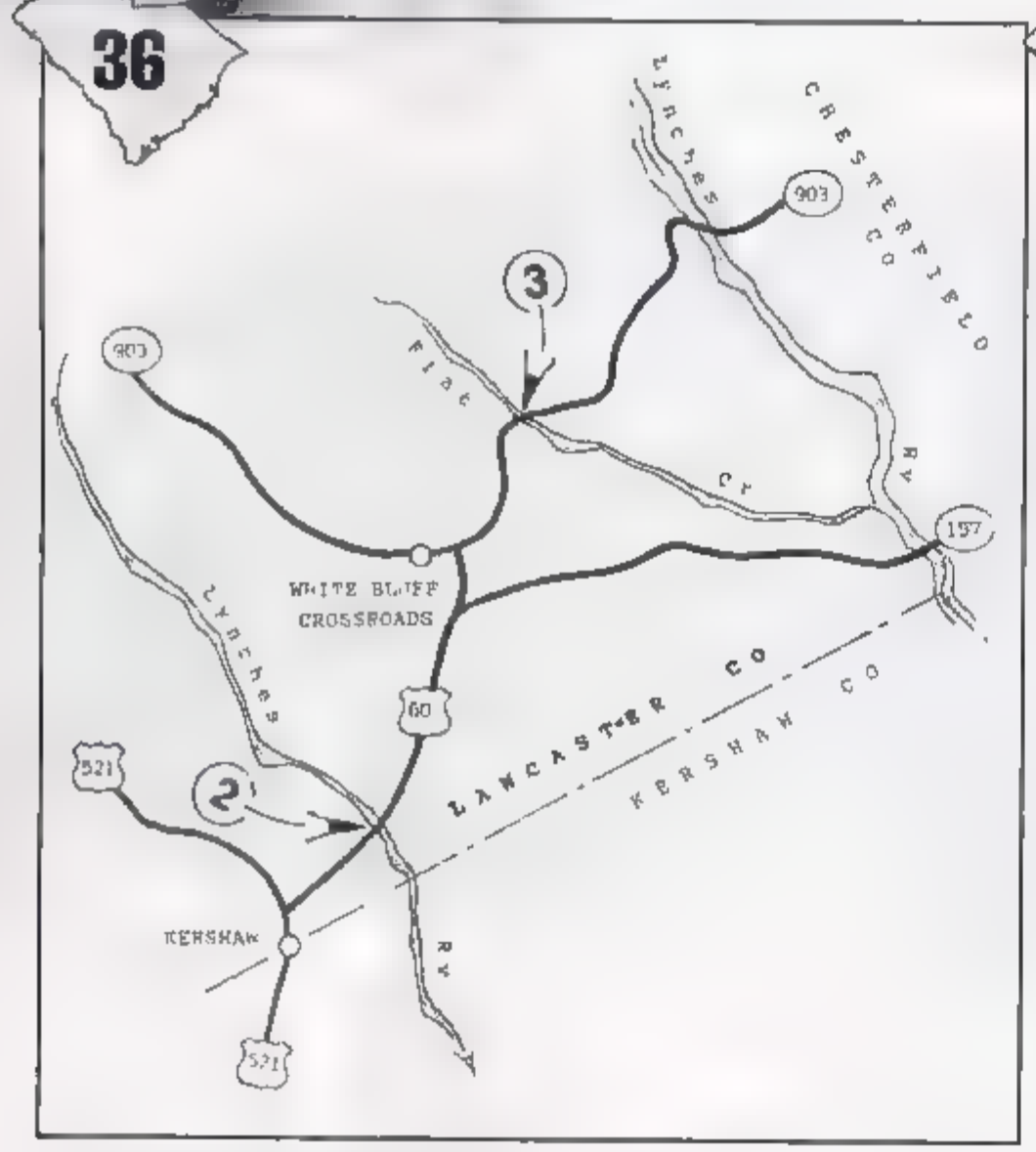
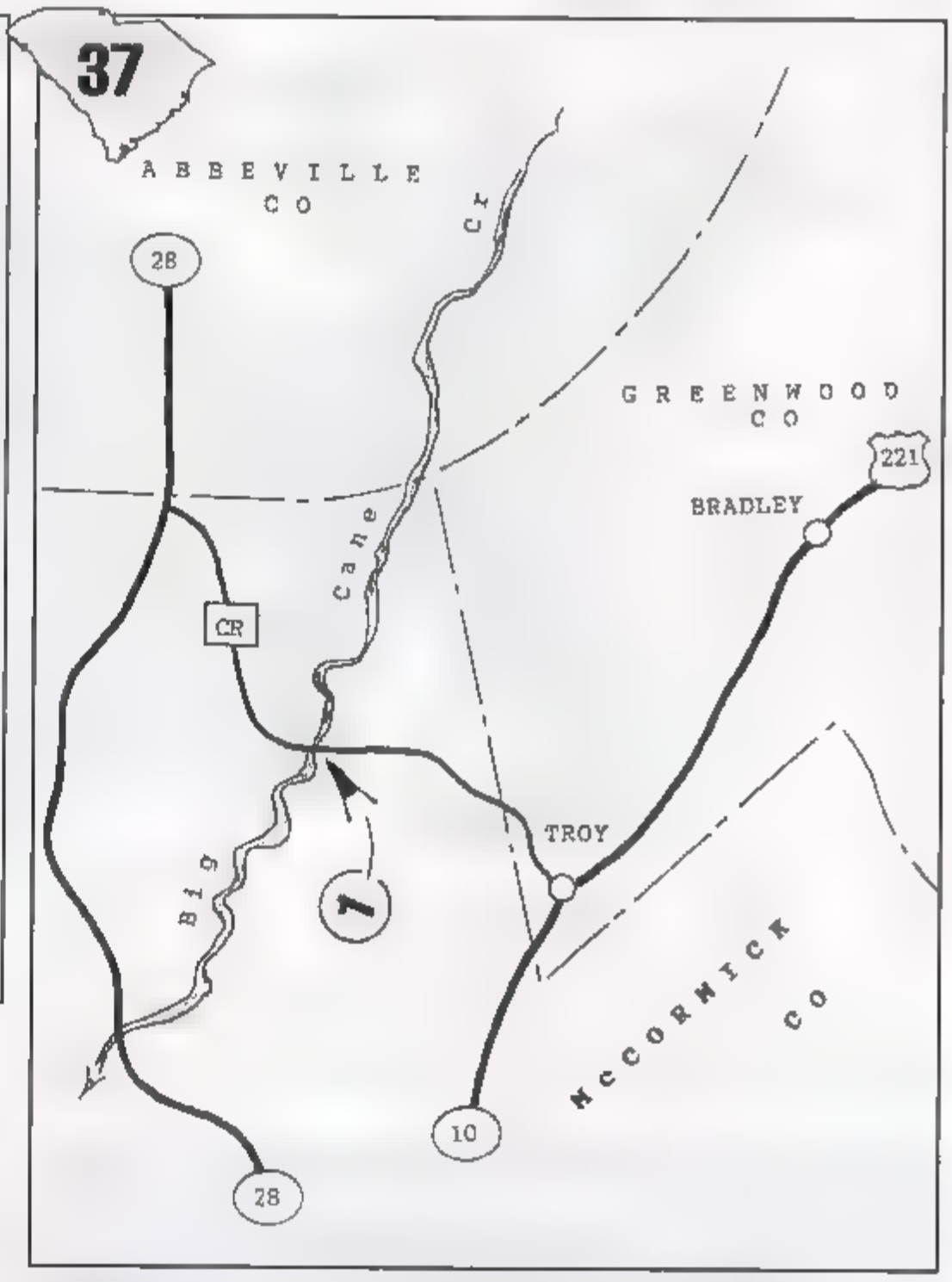


LANCASTER COUNTY (MAP SC36)

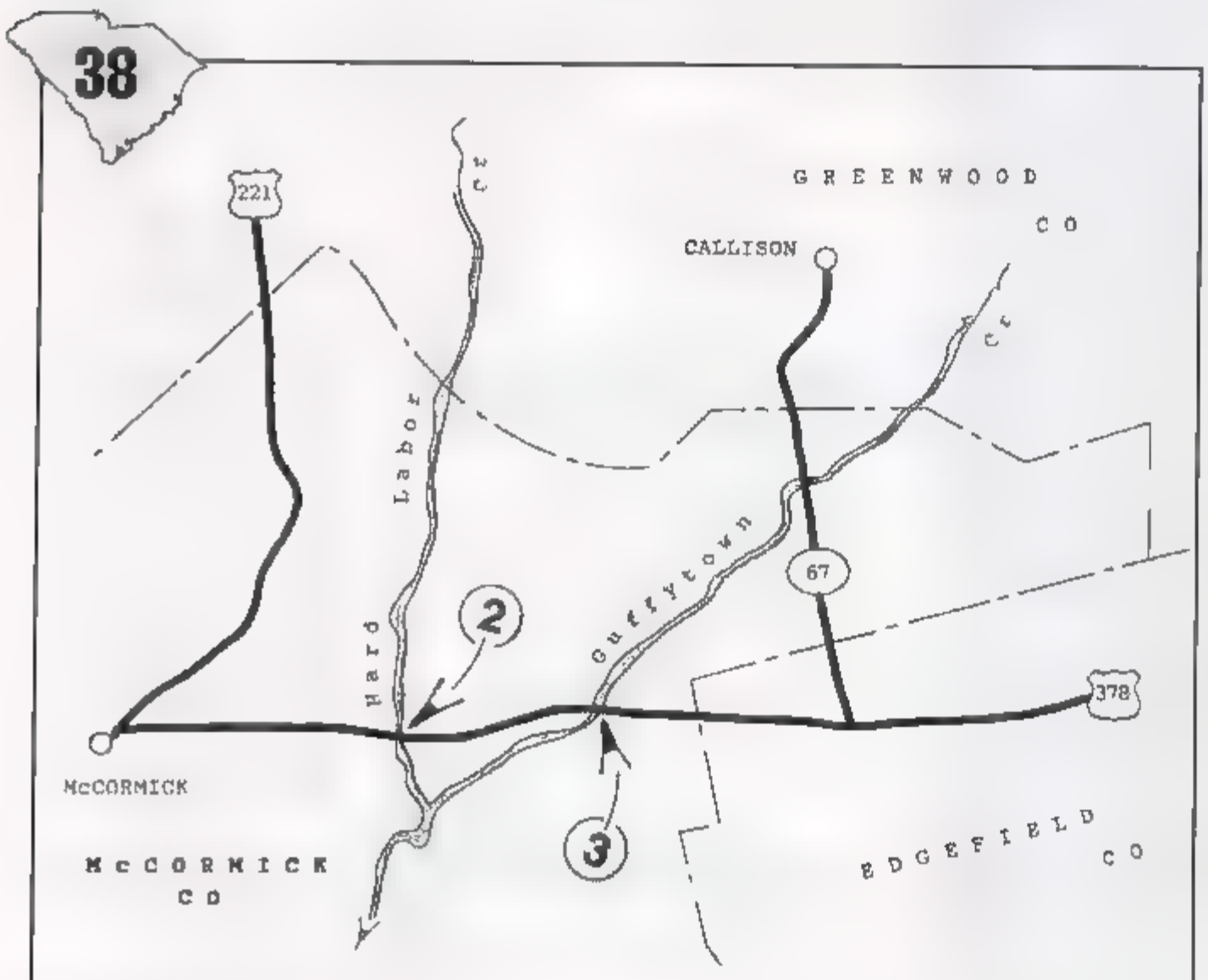
Site 2 **Lynches River/U.S. Highway 601** crossing near **Kershaw.** Vicinity finds indicate gold potential.

Site 3. **Flat Creek/state Route 903** crossing near **White Bluff Crossroads.** Vicinity finds indicate gold potential



MCCORMICK COUNTY (MAP SC37)

Site 1 **Big Cane Creek/County Road** crossing near **Troy.** Vicinity finds indicate gold potential.



MCCORMICK COUNTY (MAP SC38)

Site 2 **Hard Labor Creek/U.S. Highway 378** crossing near **McCormick.** Vicinity finds indicate gold potential

Site 3 **Guffytown Creek/U.S. Highway 378** crossing near **McCormick.** Vicinity finds indicate gold potential.

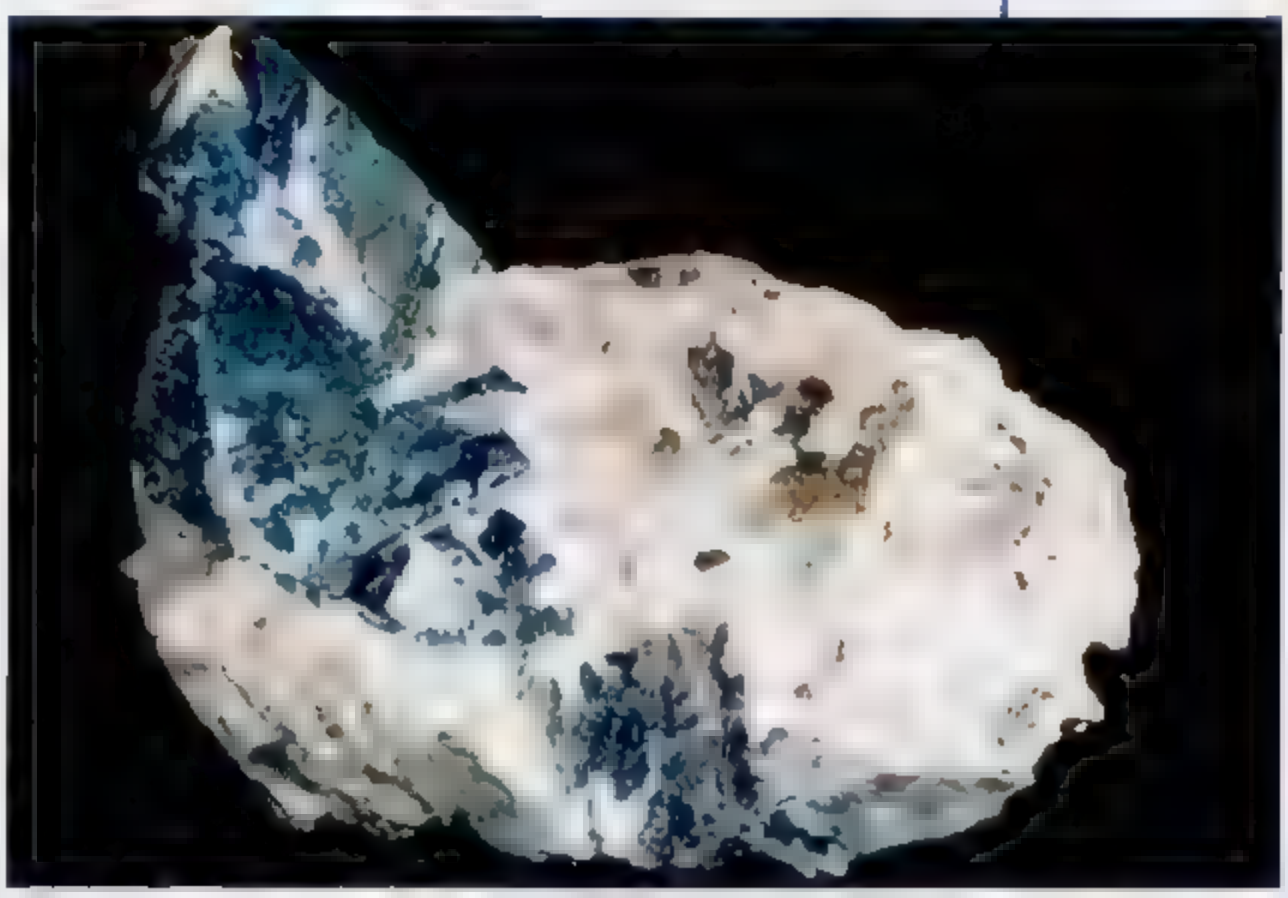
The Yuhas No. 1 mine, a sizeable feldspar producer in its time, consists of a large, water-filled pit with tunnels cut into its back wall.

NEW ENGLAND Pegmatite Minerals

Six Mines in Southwestern New Hampshire

Story and Photos by R. W. Balou

New Hampshire is officially known as the "Granite State." It's an apt title, certainly, but it doesn't even hint at the mineralogical diversity of this beautiful, mountainous chunk of New England. According to Philip Morrill's *New Hampshire Mines and Mineral Localities*, 2nd Ed. (Monadnock Museum, 1961), almost 300 different mineral types have been retrieved from or identified in New Hampshire over the years, including several commercially viable metallic ores, a wide range of strategic minerals, and almost the entire spectrum of exotic and beautiful collector minerals. Museums worldwide own New Hampshire specimens, some of them the finest examples of the species ever seen. (Reprints of *New Hampshire Mines and Mineral Localities* are available from http://barlbooks.com and elsewhere.)



Massive blue tourmaline on feldspar is commonly found at the Chickering Mine in Walpole, New Hampshire.

For the mineral collector, New Hampshire's mines—none of which are operating in an industrial sense—are a great venue in which to pursue the hobby. Accessibility is a big factor in New Hampshire, hunters and snowmobilers wield considerable political influence, and as many of these old mines are in prime hunting and snowmobiling areas, the land they sit on has remained largely unposted against trespassing. There has also been a relative lack of residential or commercial development in rural New Hampshire in the last few decades. I estimate that at least half the mines listed in Morrill's book are still legally accessible to the casual mineral collector, usually without the necessity (and nuisance) of seeking landowner permission.

Of course, in consequence, the better, more easily accessed sites have been heavily worked over by collectors over the years. Good specimens are still to be found even at the popular sites, though, if you're willing to put some work into it. And for those adventurous souls who can read a compass and aren't averse to doing some hard walking, there are mines in the New Hampshire woods that haven't felt the thump of a shovel or the crack of a rock hammer in 50 years. Morrill's book lists quite a few of these.

For someone like me with a serious interest in industrial archaeology, these old mines can be fascinating places. Likewise, to the hobby geologist, the walls of many of the old mines tell a tale of over 400 million years of mountains being formed, of land masses rising and subsiding, of magma, and of sedimentation and metamorphism taking place. Interesting and beautiful geological specimens are abundant at New Hampshire mine sites, and can often be gathered by simply bending over to pick them up.

A FEW GOOD MINES

The number of New Hampshire mines suitable for mineral collecting is huge, so I'll concentrate this article on the southwestern corner of the state, particularly the Sullivan and Cheshire county districts, which experienced the heaviest concentration of mining activity in the 19th and early 20th centuries. With the exception of the Stoddard Mine in Westmoreland, a far too interesting and productive site to leave out, all these mines were originally worked for pegmatite and its associated minerals. All are on private but unposted land, and all are what I consider "safe" sites for mineral collecting, with no unstable tunnels or avalanche-prone dumps to tempt the unwary. I have visited them all in recent months to verify their current accessibility.

Beryl Mountain, Acworth: Originally opened for mica in the late 19th century, this mine was worked for beryl during the later years of World War II. A single, concentrated deposit yielded over 20 tons of the mineral. The mine's physical structure is classic pegmatite, a magmatic dome (part of the New Hampshire Plutonic Suite, Alstead Field) intruded upward into a layer of schist, which defines its outer perimeter. The main pit is approximately 100 feet long and 30 feet deep, and is cut right into the top of the dome. A vein of snow-white Clough quartzite passes through the middle of the deposit and is a common waste rock on the dumps. Morrill's book states that there's a tunnel at the site, but I've never been able to find it. I suspect this had something to do with early mica operations and was blasted away during the beryl mining phase, or else it was buried under one of the dumps.

Minerals that have been found at the site include most of the accessory minerals likely to occur in a pegmatite mine, along with such rarities as schoepite, meta-autunite, rutherfordine, vandendriesscheite, and cyrtolite—some of which is quite radioactive. Beryl specimens taken from this mine have included all common colors other than pink (morganite). The site has also produced some truly big beryl crystals. One of these, retrieved by mineral collectors during a period when the mine was inactive, weighed somewhere around 5 tons!

On the west wall of the main pit is a rather dramatic juxtaposition of the original schist deposit from the Ordovician Period, the layer of Clough quartzite, and the thick vein of white quartz that dominates the Beryl Mountain pegmatite. The fact that the quartzite was once a deposit of sand on the ocean floor is interesting to ponder and shows just how much Earth's structure has changed in the last 500 million years or so.

From a collector's standpoint, Beryl Mountain has a reputation of being somewhat worked out, the good beryl specimens having disappeared into private collections long ago. However, the dumps at this mine are pretty deep (particularly the one at the base of the main pit) with a lot of boulder-sized chunks of quartzite and quartz mixed in with the smaller stuff. Some vigorous action with a crowbar and shovel could get the serious collector down into a level that hasn't been exposed since the mine was worked during the late days of World War II, when white or colorless beryl was being sought for industrial purposes. The colored varieties were generally tossed aside because they contained iron impu-

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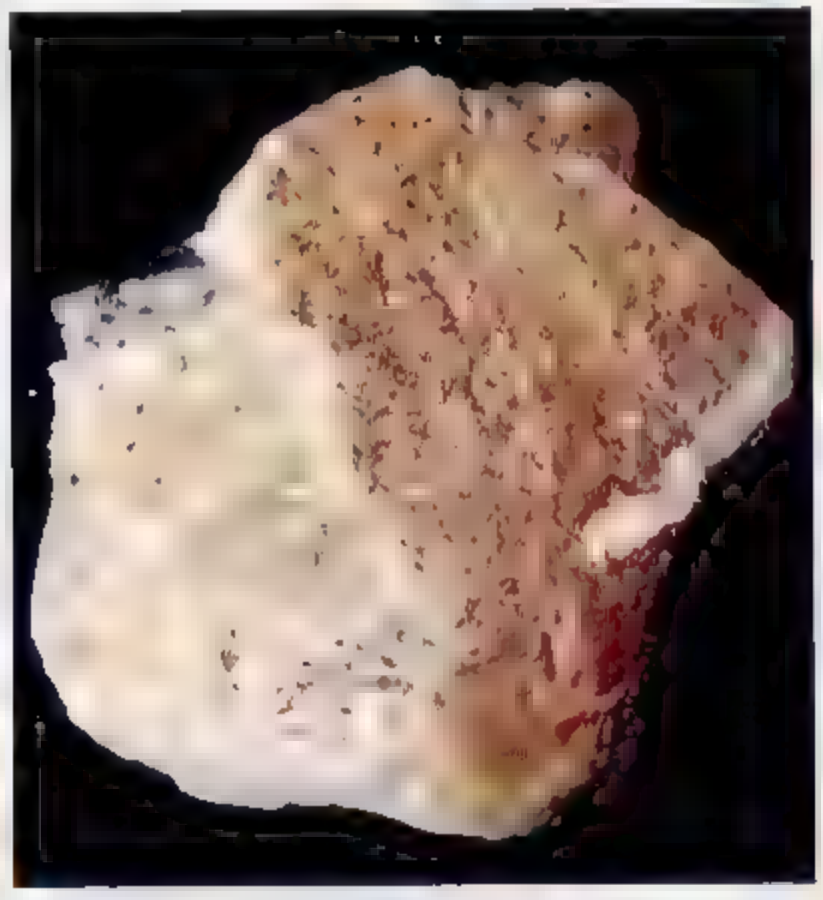
Iron contamination gives these quartz crystals from the Stoddard Mine a golden color that's not unattractive



The Yuhas No. 2 mine is noted for producing iron sulfide materials like the pyrite flakes covering this plagioclase feldspar.

rities that made refining difficult

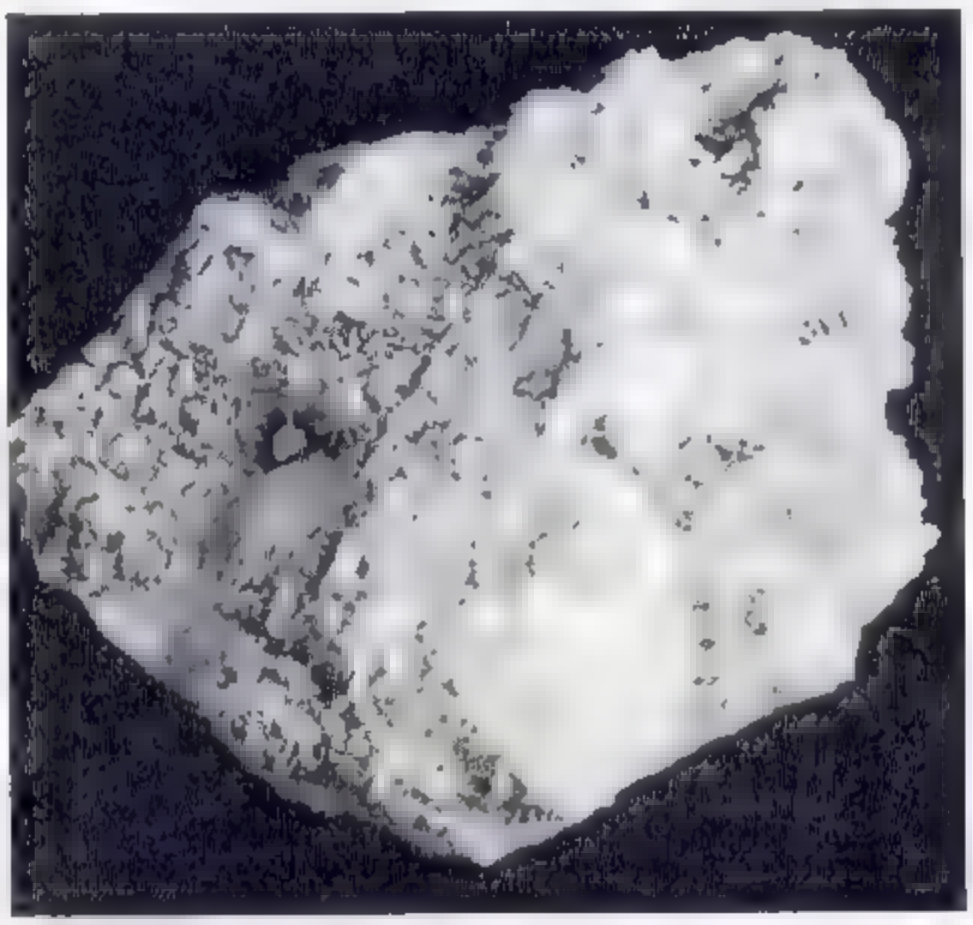
If you visit Beryl Mountain, you should also check out the Beryl Mountain Museum, located a mile south of the mine on Beryl Mountain Road. This is a sizeable collection of mining equipment, tools, and vehicles (mostly rusty) housed in two buildings. It's open by chance or appointment. The hulks of the old chain driven Sterling dump trucks that ground their way up and down the steep, treacherous mine roads of the district are definitely worth a look and give an inkling of the difficulties, both economic and physical, of pegmatite mining in the state of New Hampshire.

To get there: From state Route 123A in South Acworth, turn south on Beryl Mountain Road. At approximately 0.75 mile, there's a town garage building on the right. McLaughlin Road enters from the left directly opposite. The mine road starts on the east side of this intersection. After passing the gate, walk uphill for 0.25 mile, then bear right at the fork. You'll reach the first dump and the lower pit in 100 yards or so. The upper pit is hidden behind a thick stand of small spruce trees.

Yuhas No. 1 and Yuhas No. 2 mines, Acworth: These were both sizeable feldspar producers in their time, and the No. 2 mine was worked right up into the 1960s. They both consist of large, water-filled pits with tunnels cut into their back walls. The tunnels, along with the murky, dark-green water of unknown depth, give these mines an eerie, fascinating "presence" that inspires curiosity and invites exploration. The location of the No. 1 mine, deep in a wooded glade beside a disused forest road, could be described as charming, while the location of the No. 2 mine, right at the top of a mountain with a 50-mile view of the surrounding countryside in three directions, is downright spectacular.

Because getting to these mines involves some pretty strenuous walking, they're not often visited by mineral collectors nowadays. Also, the list of minerals these mines have produced is not very long, although a sizeable number of good specimens of various kinds have come out of their dumps over the years.

The No. 2 mine is noted for producing iron sulfide materials, including good pyrite specimens. Also, some pretty strange iron ore can be found at this mine: hellfire-and-brimstone stuff that looks like hematite, but leaches powdery yellow sulfur from its pores if you soak it in water and then let it dry. One chunk I picked up on a recent trip was almost a dead ringer for a meteorite except for its color, and had a cavity in it that contained a cluster of almost microscopic pyrite crystals. Decent tourmaline specimens have also been found here, along with interesting examples of the feldspathic minerals — not surprising, since the mine was mainly a feldspar producer.



A 7-pound chunk of quartz crystals, ranging from needle size up to ¼ inch in diameter, was recovered from one of the Stoddard Mine dumps.

A huge amount of material came out of the No. 2 mine during its working life — as much as 80 tons a day, according to one account. The size of the main dump cascading down the mountainside bears testimony to the mining effort that went on here.

To get there: Take state Route 123A north from Alstead (heading toward South Acworth) for 3.2 miles to the intersection of Livermore Road by the Cold River bridge. Just before the intersection, there's a washed-out, mineral-covered road directly across from a wooden house with a conspicuous front gable. This is the mine road. Walk in 100 yards and bear right at the fork, then continue uphill for 200 yards to a second fork. Bear left here; this is a snowmobile trail that follows the western flank of the mountain. At approximately 0.75 mile, a very steep, mineral-covered road enters from the left. 0.33 mile up this pitch is the No. 2 mine. To get to the No. 1 mine, stay on the snowmobile trail a short distance past the No. 2 road; the dumps are obvious by the intersection. There's another small, but complete, working with its own dump about 100 yards up the No. 2 mine road.

Big Mine, Alstead: This started out as a mica mine in the 19th century. The deposit was discovered by a local farmer while searching for his lost sheep. Originally known as the Gilsum-Bowers Mine, its production switched over to mostly feldspar during World War I and right up into the late 1930s. Approximately 240,000 tons of feldspar were eventually blasted and hauled out of the Big Mine, making it probably the second biggest feldspar producer in the state. As the Big Mine grew in size, it swallowed up several smaller mines, including the Rhoda (an early mica mine), the Davis, and the Tripp No. 2.

When World War II started and the demand for mica drastically increased, the Golding-Keene Co. decided to put it back into operation for the extraction of mica only. It pumped out 13 million gallons of water, and sunk tunnels under the floor of the main pit and off its sidewalls to follow previously-ignored mica veins. The name of the mine was changed to "Victory" in honor of the war effort. In the single month of July 1944, 45 tons of mica were extracted, largely of a rum-colored variety occurring in books up to 5 inches thick.

Today, the Big Mine lies dark and silent, vegetation gradually concealing it from casual sight. With the exception of a part-open, part-underground "alcove" at the mine's northeast corner (this was originally the Tripp No. 2 mine), all the tunneling done during World War II now lies under almost 200 feet of cold, black water. And the once-huge dumps have been significantly reduced, with much of the material being hauled away for road fill by the local highway department. One can only wonder what kind of great mineral specimens lie hidden under Alstead asphalt!

Minerals found at the Big Mine have included all the usual pegmatite-related minerals, as well as autunite, gummite, montmorillonite, uraninite and uranophane. Gem-quality garnets and a lot of black tourmaline have come out of here. Despite the robbing of the Big Mine's dumps, there is still a huge amount of waste material scattered around the site, much of it hidden under topsoil or vegetation. The old Davis Mine, which forms the southwestern corner of the Big Mine, went very deep and served as access to two tunnels that went under the floor of the main pit. Its dumps would definitely be worth investigating.

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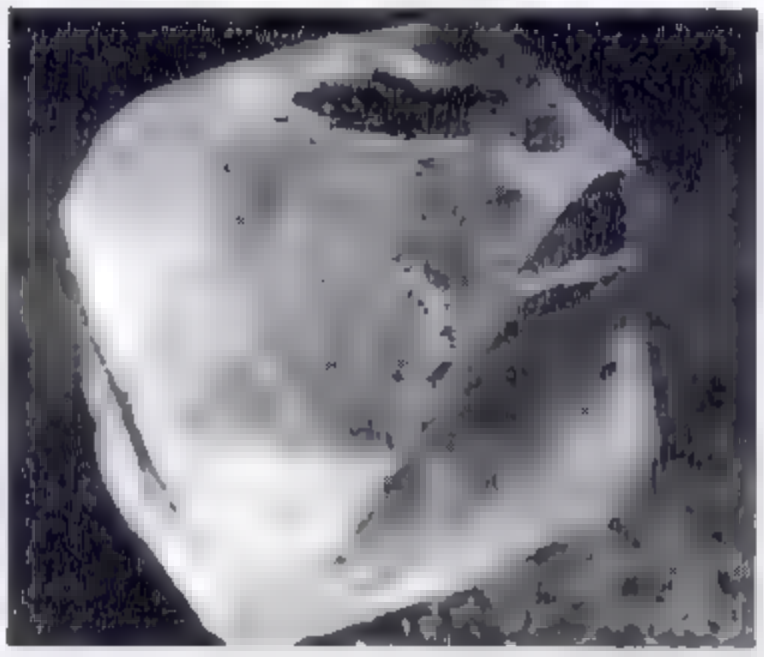
There are numerous other pegmatite mines within a short distance of the Big Mine. Several of these are still accessible to collectors and still capable of producing good specimens from time to time. If you're traveling in the vicinity, the Alstead town clerk has a hand-drawn map showing the locations of many of these mines that she'll photocopy for a small fee. The New Hampshire Rocks Web site, http://groups.msn.com/NewHampshireRocks, has a very detailed, but hard to read, map showing the location of virtually every mine in the area, as well as several site-specific maps, including one for the Big Mine.

An interesting industrial archaeology site nearby is the ruins of the Kidder Pond flotation mill, built by the Golding-Keene Co. in 1948 to produce pure-white ground feldspar for the Corning Glass Works in New York. Much of the mill's ironwork is still intact, as well as one of the huge silos used to store the finished product. On the shore of the pond in front of the ruins is a sizeable white sand "beach" comprised entirely of ground feldspar. The Osborne Mine, producer of truly giant beryl crystals at one time, is close to the mill, reached by a branch off the Kidder Pond road.

To get there: From state Route 123 in East Alstead, turn south on Gilsum Mine Road. At 3.1 miles, the entrance to the Big Mine will be on your right. The mine is near the road, hidden behind the trees. To reach the flotation mill ruins, continue south on Gilsum Mine Road for 0.25 mile, then turn left (east) onto Kidder Pond Road. This is a pretty rough road, don't try it in your Aunt Mildred's Buick Electra. The mill is at the east end of the pond where the road ends (approximately 0.5 mile).

The Lyman and Fitzgibbon mines, Alstead: These are directly across the road from one another and were at one time operated by the same company, the Fitzgibbon Mica Co. of Beverly, Massachusetts. Both were worked mainly for mica, the Fitzgibbon being a particularly spectacular producer for a mine of its size. The Fitzgibbon has also put a surprising variety of mineral specimens into the hands of rockhounds over the years. Morrill's book lists more than 20 different minerals collected here, including vivianite, xanthoxenite, zircon, strengite, dufrenite, pyrolusite, rockbridgeite and more common minerals like tourmaline and apatite. Obviously, this was a pegmatite formed from some extremely chemically diverse magma, and one can only wonder what other minerals it might have produced if the mine had been worked longer or gone deeper.

On a recent trip to the Fitzgibbon Mine, I found a 200-pound chunk of quartz with a 2-inch thick slab of massive black tourmaline bisecting its entire width lying in the weeds. It's probably still there. I took home some pretty major-sized books of mica. Someone who'd gotten there before me took home a book of mica the size of the family Bible, judging by the depression in the rock out of which it had been pried.



Fluorite octahedrons can still be found at the Stoddard Mine. This one is mostly colorless with a slight trace of purple.

To get there: From the intersection of Gilsum Mine Road and state Route 123 in East Alstead, head north through the village, continue for 1 mile, then turn right (east) onto Corbin Road. Take Corbin Road 0.5 mile. The Fitzgibbon Mine will be on your left, its entrance right at the road's edge, but somewhat hidden by brush. The Lyman Mine is directly across the road.

The Chickering Mine, Walpole: This is a smallish mine, a half-circular cut in the face of a typical magma intrusion in the country rock. It's on the grounds of a Boy Scout camp, and the scouts use the mine as a natural amphitheater in which to hold their campfire singalongs or whatever. The mine's dump material is scattered over a surprisingly large area, making the dumps shallow and easy to dig. This is a good site for the casual mineral collector who isn't expecting to find museum-quality specimens.

The Chickering Mine is, however, noted as a good tourmaline producer. Blue and green tourmaline are the most common here, although on a recent visit I found a sizeable dravite crystal, the brown form of tourmaline. This came attached to a rather ugly chunk of quartz with mica "warts" sticking out of it.

There's also a sizeable vein of hematite ore in one wall of the pit, although I haven't heard of any great iron-related specimens coming out of here. A great deal of dump material, much of it boulder sized, is lying in the main part of the pit, covered by an accumulation of duff and whatnot. A crowbar and shovel could be helpful in working the Chickering Mine. I suspect this layer of material is deeper than it looks.

To get there: From state Route 12 N., turn right onto state Route 123 E. at Cold River. Go 0.5 mile and take the right fork onto Walpole Valley Road. Continue for 3.1 miles to Eaton Road on your right. After 0.25 mile or so, Eaton Road turns into a one-lane, two rut cow trail that's easily negotiated by an SUV or pickup, but might tear the muffler off the family sedan. Continue for 0.75 mile to an open clearing on your right with a granite signpost beside it: this is the parking area for the Boy Scout camp. The mine is a couple hundred yards uphill from the parking area.

The Stoddard Mine, Westmoreland: Strictly from a mineral-collecting standpoint, I've saved the best for last. The Stoddard is a fluorite mine that was first opened in 1906 when a vein of the mineral was discovered protruding from a cow pasture. H.M. Bannerman, the New Hampshire state geologist who visited the site in 1927, described the mine's geological structure thus:

> "The fluorite deposits in Westmoreland, New Hampshire, occur as fissure fillings in a series of tension fractures in granite gneiss. The veins being worked are from 3 to 5 feet in width, and some of them have been traced laterally 500 to 600 feet. They dip approximately 70 degrees, the foliation of the gneiss in which they lie is generally quite flat. The veins are banded, crustified, and replete with open cavities. The fluorite is accompanied mainly by quartz, but considerable quantities of barite, calcite, dolomite, kaolin, and sericite are present, and streaks of such sulphides as chalcopyrite, pyrite, sphalerite, and a little galena appear throughout the deposits, together with some finely crystallized malachite and smithsonite." (*New Hampshire Minerals*, New Hampshire State Geologist, 1955, p. 28).

At first worked on a small scale, the deposit grew in importance with the outbreak of World War I. During this time, the mine was owned by the American Steel and Wire Co. of Worcester, Massachusetts, which used the fluorite as a fluxing agent in steel making. Production went on around the clock, with the mine producing 1,600 tons of fluorite during 1918. This was valued at $25 per ton during the war years.

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New England *from page 44*

Originally worked entirely by hand, the mine went over to steam power, compressed-air drills, etc. in 1912. Fluorite was transported the half-mile from the mine to the town road by an overhead tramway consisting of buckets slung from a moving cable, with wooden uprights supporting the cable at intervals.

Three separate mines actually comprised the Stoddard operation. The earliest of these was the so-called Big Mine, a deep, narrow cut that followed the fluorite vein for several hundred feet. A later, smaller cut nearby proved to be a poor producer. The third opening was known as the Ox Pasture Mine, worked by a vertical shaft 130 feet deep with horizontal drifts heading east and west off its lowest depths. The longest of these was a tunnel, 80 feet long, which at one point broke through into a vug that was described by those who saw it as a virtual "crystal cave." Much of the crystallized material found on the mine's dumps probably had its origins here.

Operations ceased, to all intents and purposes, in 1923. While the mine may have no further commercial value, the Stoddard can be a very productive site for the mineral collector. Quartz crystals abound, usually in large clusters of smaller crystals, although sizeable single specimens turn up from time to time. The fluorite here runs from colorless through green to purple; fluorite octahedrons can be found if you're patient enough to dig for them. Also, specimens of all the other minerals Bannerman described can still be found here, with barite being a fairly common occurrence. The dumps of the Ox Pasture Mine, which are generally shallow and scattered around the site, might be a good place to start your mineral search. Some wet and vigorous digging in the bottom of one of the side pits worked into the vein might prove more productive.

To get there: From the traffic circle at Interstate 91 Exit 3 in Brattleboro, Vermont, head east on state Route 9 for 4.2 miles, then turn left (north) on Poocham Road. Continue north for 3.2 miles until you see the sign for the VanZandt Williams Family Preserve on your left. Directly across from the preserve is an open field; the mine road starts on the northern edge of the field. A half-mile of easy walking will take you to the Ox Pasture Mine; continue up the road a short distance to reach the other two openings.

Happy hunting!

ROCK & GEM

Make an Emergency Backpack

A field trip is exciting partly because it holds an element of surprise: You never know what you're going to find. An emergency is one type of surprise you can do without, but when you go into the field, you need to be prepared for one. Since many field trips take you to remote areas without modern conveniences, you will need to bring certain items. People always need the same emergency supplies: clean water, first aid supplies, food, and shelter.

Water is the most critical item. Each person and pet needs 3 gallons of water each day to survive. When you go on a collecting expedition, take as much clean water as you can carry in plastic jugs or other containers.

The following items will sustain two people for two days in most emergencies:

- 12 gallons drinking water (minimum)
- 24 individually wrapped 200-calorie food bars
- 4 emergency survival blankets
- 8 air-activated hand warmers
- 2 ponchos with hoods
- a first-aid kit
- 2 12-hour light sticks
- 2 flashlights with extra batteries
- 2 whistles
- matches in a waterproof container
- a multifunction knife
- leather gloves
- 2 5-foot by 7-foot tarps
- a pry bar
- an AM/FM radio with extra batteries
- 1 50-foot rope

- 1 roll of heavy-duty trash bags
- playing cards, paper and pencils, a harmonica or flute

Your first aid kit should contain:

- gauze pads, gauze rolls, and Band-Aids
- antiseptic wipes and ointment
- scissors and tweezers
- eye wash and an eye pad

Having the following hygiene supplies can help make you more comfortable:

- 2 rolls of toilet tissue (use it sparingly!)
- Wet Wipe sanitizers
- plastic bags
- toothbrushes and toothpaste
- soap

Add personal necessities, such as medications and contact solutions, to the list. Pack these items in a large backpack and keep it near you on your field trip. You never know when it will come in handy!

KIDS

by Steve Bucko

Datolite

The name datolite comes from the Greek *dateisthai*, meaning "to divide," because granular aggregates of datolite crumble readily. The name "botryolite" was applied to the **botryoidal** variety of datolite.

Chemically, datolite is calcium boro-silicate, $CaBSiO_4(OH)$. It has a Mohs hardness of 5 to 5.5, and its specific gravity is 2.8 to 3.0. Its fracture is **subconchoidal** or irregular, and it has no cleavage. The luster is **vitreous** in crystals or **porcelaneous** in the nodules. Datolite may be transparent, translucent or opaque, and it makes a white streak.

Datolite belongs to the monoclinic crystal system. Its crystals are pale yellow to greenish-yellow and white. Its crystal habits include short, prismatic crystals and spheres with radiating internal structure. The type locality, Arendal, Norway, has produced both the compact massive variety and crystals. Today, well-formed crystals of datolite come to market from Dal'negorsk, Russia

Datolite from the copper country of Michigan's Keweenaw Peninsula forms nodules of rose, pink, orange, yellow, pale green, purplish, white, gray, brown and black. Some massive nodules are said to look like a head of cauliflower. Broken surfaces show the true color of the mineral, while weathered surfaces appear chalky white. Microscopic particles of native copper and **alteration products** may cause some colors.

The nodules can be up to 18 inches in diameter, and their colors may be mottled or concentrically zoned. Cabochons cut from concentrically zoned datolite nodules may resemble eyes.

Three classic Keweenaw Peninsula localities are the Delaware Mine, the Pewabic lode (Quincy, Mesnard, and Franklin mines), and the Caledonia Mine.

Artists have used datolite for scrimshaw, a process in which designs are engraved into slabs of the porcelaneous mineral, which is then dyed to make the designs stand out.

Associated minerals may include native copper, albite, amphibole, apophyllite, chlorite, fluorite and pectolite.

GLOSSARY (Use your dictionary to look up other words you don't know.)

botryoidal resembling a bunch of grapes

subconchoidal a type of fracture with a curving surface that is not so definite as the conchoidal fracture of obsidian or glass

porcelaneous like porcelain

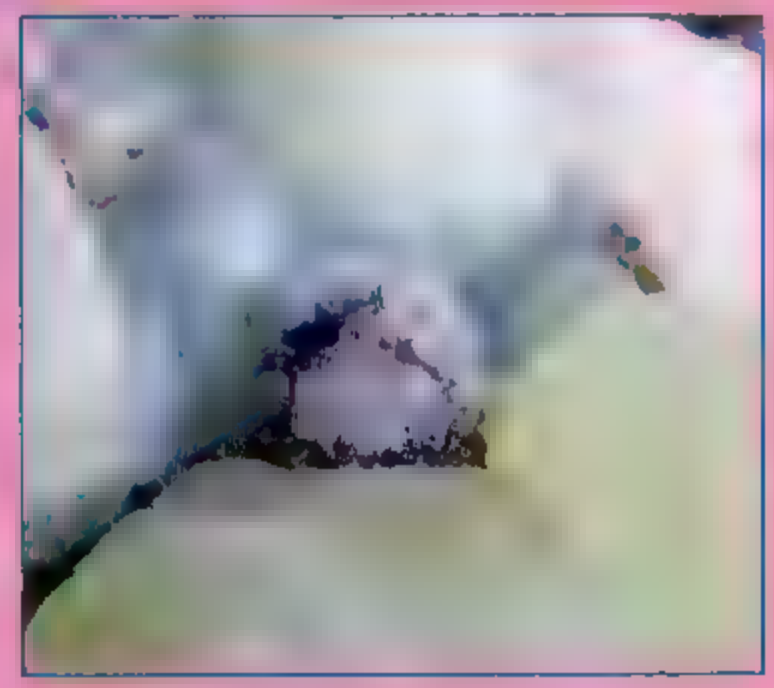
vitreous resembling glass

alteration product a chemical compound formed by the effects of weathering on minerals and rocks

Rock & Gem Kids Quiz

The *Rock & Gem* Kids Quiz contest is open to U.S. residents age 18 and younger. All these questions can be answered by carefully reading this column. Write your answers neatly on a postcard or 4X5 card and mail to **June *Rock & Gem* Kids Quiz, P.O. Box 6925, Ventura, CA 93006-9899.** Valid entries received by **June 30, 2007** will be entered in a drawing from which five winners will be chosen. Valid entries must be the entrant's own work and must include the correct answers, the entrant's name, age and address, and the signature of a parent or guardian. Prizes are generously provided by the Arizona Mineral and Mining Museum Foundation.

1. How much water does a person need each day to survive?
2. What four things do people need in any emergency?
3. The Michigan peninsula that is known as "copper country" is the ____.
4. Datolite's crystal habits include ____, ____ crystals and spheres with ____ ____ ____.
5. Three minerals that may be associated with datolite are ____, ____ and ____.



New Facts about Old Fossils

Study suggests the shield at the back of Triceratops head may have been for display and not for defense.

A Traveling Exhibition Sheds New Light on Ancient Creatures

Story and Photos by Murray Eiland

To those not fully aware of the controversies, the field of paleontology is dry and boring. In fact, however, the last decade has seen the explosion of some old theories, revisions of others, and a host of new ideas entering the field. Important new fossil finds have been made in the last few years, but too much of this information has remained in the domain of specialists. A traveling exhibition of fossils that visited the California Academy of Sciences in San Francisco from Sept. 6, 2006 through Feb. 4, 2007 covers this new ground.

Dinosaurs: Ancient Fossils, New Discoveries was organized by the American Museum of Natural History in collaboration with the California

Scientists have developed new theories on the way *Tyrannosaurus rex* moved.

Academy of Sciences, the Houston Museum of Natural Sciences, the Field Museum, and the North Carolina Museum of Natural Sciences. It features exhibits geared for children and adults. Casts, models, real fossils, and video presentations are used to convey information that may be difficult to visualize.

There is plenty of interesting material, even on the well-known dinosaurs. A major theme of the exhibit is the debate over why the various projections evolved. While many scientists believe that some appendages could be used as armor or for muscle attachment, the "flirt over fight" theory is gaining ground, suggesting that such things as the plates on a stegosaurus or the shield on a ceratopsian was used for courtship display, much the way modern birds use their plumage.

While one could imagine that the horns on many ceratopsians can be used for combat, the advocates of this theory contend that the most elaborately developed structures, such as the plates of a stegosaurus, are too thin to serve as armor. Furthermore, they cite that there is no evidence the large shields on ceratopsians served as a structure for muscle attachment. Such shields, like the plumage of a bird, could assist species in recognizing mates or in territorial displays. The modern rhinoceros, for example, uses its horns for combat, although they may have a secondary purpose for display.

Sinornithosaurus could run down food and may have been able to use its wings to scoop it up.

A 40-foot-high model *Tyrannosaurus rex* is a prominent feature of the display. There is a small, walking model and a video presentation details recent developments dealing with the mechanics of this animal's locomotion. It is interesting to note that the detailed walking skeletal model has the animal place its feet like a ballet dancer, toe first. In contrast, the video shows the animal lumbering along, placing the foot on the ground all at once. This is perhaps only a glimpse of the controversy that exists in the professional world.

The main new method of research here is biomechanics. This science involves a detailed study of the muscular system, while previous studies have concentrated on the bones. Video and computer analyses of elite sports figures aid in this study, which has been applied to dinosaurs. Recently, theories have been proposed that the structure of *T rex* is more adapted to scavenging than hunting. New research suggests that it was not capable of supporting the large muscles required for running. Some suggest *T rex* could run up to 45 mph, but recent computer projections suggest that to reach this speed the animal would require 3 tons of leg muscles. Other scientists suggest that *T rex* could have propelled itself at about seven to 10 miles an hour. *T rex* may have been fearsome, but he or she was unlikely to be a sprinter.

One of the most interesting exhibits is a 60-foot-long steel dinosaur. Apatosaurus, previously known as Brontosaurus, was a Jurassic-period sauropod that lived about 140 million years ago. One of the largest land animals ever, it stood about 15 feet tall at the hip and was about 70 feet long. Weighing 40 tons, it has been thought to be partially aquatic. The main question is, how did it use such a long neck and long tail? Could the head of the animal be extended into the trees to forage for food like a giraffe?

The first hypothesis, that the animal was too massive to support its own weight, appears to be incorrect. It has a near relative, Diplodocus, that also appears to be a grazing animal that used a long neck counterweighted by a long tail to gain access to food. Clearly, the neck was important, but could it stretch up to 90 degrees?

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The answer appears to be no, despite the fact that most films depict this dinosaur as something like an ancient giraffe. Recent biomechanical analysis of the neck suggests that it was much less flexible than previously assumed. It is likely that the neck was largely used for reaching up a stream bank or across a ravine for food rather than for foraging in the treetops. Many sauropods had long front legs that would allow them, even if the neck were held parallel to the ground, to graze at about 20 feet off the ground. Apatosaurus and Diplodocus had shorter front than rear legs. New theories suggest that this allowed the animal to graze at a lower level than their relatives. What may be counterintuitive at first is a new idea today. But that is not the end of the controversy.

Some sauropod tails could be quite large. Diplodocus has a tail with 73 vertebrae, and Apatosaurus' tail had 82. They could clearly be used to counterbalance a long neck, but there may have been other uses, as well. The tails on these dinosaurs narrow to a relatively fine point. Computer modeling suggests that the tip of the tail could be used as a weapon like a whip, perhaps even with enough force to break the sound barrier. Anyone who has ever kept an iguana will realize that, on a creature the size of Apatosaurus, this would indeed be a very dangerous weapon.

One of the most interesting models is the Bambiraptor. This small, birdlike dinosaur is named after the famous Disney character and the family who bought and donated the specimen to the Graves Museum of Natural History in Florida. In a story that proves there is much left to be found, a 14-year-old fossil collector and his parents found this specimen in 1995 near Glacier National Park in Montana. He quickly identified the specimen as important because it was so complete, and after excavation by professionals it was found to be about 95 percent intact. It is a unique specimen in an excellent state of preservation.

Bambiraptor dates from about 75 million years ago, and would have stood no higher than about a foot off the ground and been a little over 2 feet in length. Weighing only 4 ½ pounds, it is assumed to be a juvenile. Like the roadrunner, which it superficially resembles, it has an S-shaped neck, the pubic bone in the hip points backwards, the wishbone is V-shaped, and it has folding arms and three primary toes. This little dinosaur also had large eyes and a long tail. Although no feathers were found, many artists have reconstructed it with feathers because the skeleton resembled a bird's so closely. The creature's brain case is particularly interesting, as it is in the lower range for modern birds. Despite the cruel jokes about bird brains, they do indeed have larger brains than dinosaurs had. An enlarged cerebellum in particular could indicate that Bambiraptor was a very agile animal, and some have suggested it could have lived in trees. This is indeed an interesting hypothesis. Further specimens are eagerly awaited.

Beipaosaurus inexpectus is among the largest feathered dinosaurs.

In recent years, the fossils from Liaoning Province in Northeastern China have become a major point of interest to professional paleontologists. In the Cretaceous paradise, forested lakes offered ample opportunities for wildlife, but there was a darker side that boded well for science. Nearby volcanoes were also active at this time. They could send out deadly gas that could quickly kill even fast-moving animals. Powdery volcanic ash could then rain down, sealing away a snapshot of this ancient environment. While many fossils formed in sediments that were deposited by water and were damaged in the process, this ancient site has preserved very delicate structures, such as feathers. This has fueled a long-standing debate. Did dinosaurs have feathers? How did birds evolve from dinosaurs? And of course, why did birds evolve from dinosaurs?

A main attraction of the exhibit is a 700-square-foot diorama billed as the most detailed recreation of a prehistoric environment. This crescent-shaped exhibit really does give you the impression of standing in an ancient forest. Many of the details, from the plants to the small animals such as insects, appear correct and

The walking model of *T rex* lands with its toes first. Did this heavy dinosaur walk in this delicate manner?

are displayed as if they are in motion It presents an image of the area over time and space This is particularly important when attempting to appreciate the ancestors of modern birds.

Birds in flight and insects are all intricately linked, although no one is now sure how or why flight evolved in birds. Feathers are a critical element in the argument The flight feathers of a modern bird are actualy quite complicated, but it should be noted that there are different kinds of feathers. For example, chicks without flight feathers have down, which keeps them warm Many adult birds have down feathers for the same purpose It seems dinosaurs, too, had feathers to keep them warm. These early feathers, essentialy thin, hollow filaments, appeared about 150 million years ago. Down is basically a tuft of these filaments, and appeared later Over time these tufts became more organized, and numerous filaments radiated from a central shaft.

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New Facts about Old Fossils *from page 65*

The flight feather is a marvel of engineering. The shaft is off center, and the filaments radiating from the shaft are locked together so that the air does not dislodge them. A bird's flight feathers cling together something like a zipper. Under the microscope, one can see that each filament has a small series of interlocking hooks.

T. rex lived in North America about 66 million years ago. A small relative from the same family of dinosaurs lived in China. Called *Dilong paradoxus*, the creature looks like a little *T. rex*. The name is derived from the Mandarin Chinese word for "emperor" and "dragon," and the paradox is the feathers that were found on the 5-foot-long animal that lived about 130 million years ago in the Early Cretaceous. It has a large mouth, smaller forelimbs, and large hind legs for walking or running. The tail, a counterbalance, also looks like that of its larger relative. What is different about this dinosaur is that it has a coat of fine, featherlike fibers.

The feathers were certainly not used for flight, but they may have kept the creature warm. *T. rex* was alive long after this animal. Does this fact suggest that *T. rex* also had feathers? Some scientists contend that it is likely a baby *T. rex* did have feathers to keep it warm. Big dinosaurs, with a lower surface-to-mass ratio, would not need feathers to keep them warm. Proponents of this theory point to the fact that elephants and other large tropical animals do not need a coat of hair to keep warm.

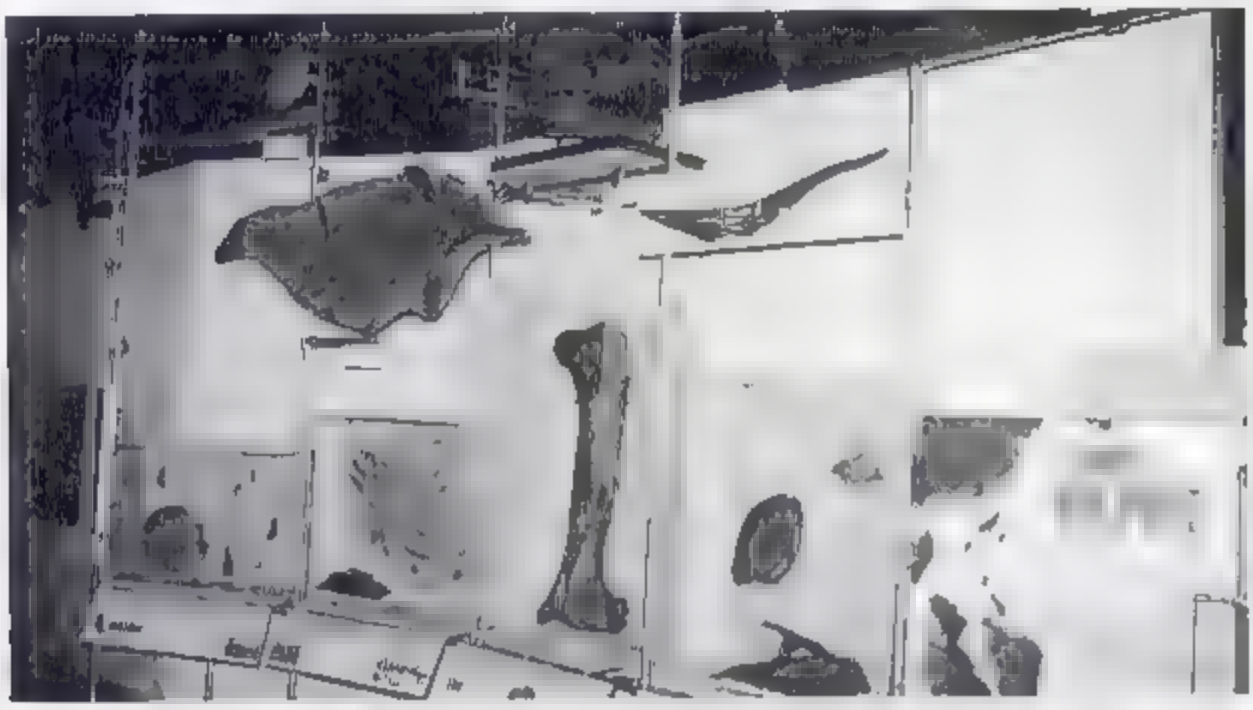
The ability to fly or glide opened up new possibilities for creatures. Insects had evolved flight some time before, and they could provide a steady source of food for a flying animal. Also, an animal that could move from place to place by leaping or gliding could escape from predators. Finally, considering that many early dinosaurs used their feet as weapons, wings could allow the feet to be used more effectively in fighting as well as in getting food.

An eye-catching pair of dinosaurs in one diorama have are named *Mei long*. Dating to the Early Cretaceous, *Mei long* is a theropod, like *T. rex*, with a large brain and eyes and distinctive teeth. The name, which suggests the attitude in which the first specimen was found, translates from the Mandarin Chinese into "soundly sleeping dragon." This is the first example of a nonavian dinosaur found asleep, and is significant because of the posture. As modern reptile keepers can attest, reptiles do not sleep in a bird-like posture, with the head tucked under the forelimb; this requires a long and flexible neck. It is thought that birds do this to keep warm. Did this dinosaur do the same?

Microraptor gui dates from the Early Cretaceous period and had feathers that appear like those of a modern bird. The feathers were asymmetrical, which suggests that the bird could fly properly, but it is still uncertain whether it could fly or glide. The feathers on the hind limbs and on the long tail are not ideal for powered flight. It has, in effect, two sets of wings. This is not such a surprise, as the specimen of Archaeopteryx has short flight feathers on the hind legs, as well. It is thought that the feathered legs and tail could be used for maintaining balance as well as for changing direction. The animal may have been a glider and not a flier. The fossil feathers can have bands of light and dark, which suggest the color scheme in life.

Caudipteryx zoui is an Early Cretaceous dinosaur that looks something like a large chicken because it has true feathers similar to those of modern birds. Despite the rather predatory appearance of the animal, it is thought to be herbivorous. Two species were recovered from Liaoning in 1997. Their well-developed feathers have a stiff central shaft with barbs radiating from the core, but unlike the feathers of a modern bird, they were symmetrical. The wings of the creature are too short for flight. This is yet another animal that seems to lend support to the hypothesis that dinosaurs were the ancestors of birds. However, others suggest that Caudipteryx and their relatives are true birds that evolved from nondinosaur ancestors. According to this view, this flightless bird could have evolved from a flying ancestor like Archaeopteryx.

Sinornithosaurus millenii is seen in the display chasing a small insect. Its name translates into English as "Chinese lizard bird." This animal lived in the Middle Cretaceous period (125 million years ago) and is the fifth known feathered dinosaur genus to be discovered. It is very closely related to birds, and had feathers of a more complicated type. Sinornithosaurus has been reconstructed with a range of feathers; fossil evidence suggests it had three kinds: simple filaments that looked like hair, downy tufts, and modern, stiff feathers that could be used for flight. Several filaments were joined together to form tufts. In other feathers, a row of filaments were joined together on a main shaft. This would make them similar to modern bird feathers, but one important feature is lacking. They do not have the little hooks that link the filaments together as in modern birds. Therefore, the feathers were not nearly



The exhibits give plenty of interesting information, even on the well-known dinosaurs.

as mechanically strong as those of modern birds.

An important consideration is that these creatures were feathered runners. One hypothesis is that birds developed from gliders who spent time in the trees. Of course, both modes of flight could be evolving at the same time. No one would be willing to suggest that Sinornithosaurus is in a direct line of descent leading to modern birds, but at least it does give weight to the theory that feathers were used for insulation and display.

A little more controversial is the idea that the feathers would be used as something like a net. In the diorama, the Sinornithosaurus is about to make a meal of an insect. It has apparently run its food down and is "boxing" the insect in front of its mouth with its wings. No one can be sure that Sinornithosaurus hunted this way, but from the fossil evidence, it is clear that it is the first dinosaur with a birdlike shoulder, as well as very long arms. It could certainly flap.

During the Mississippian age (320 million to 354 million years ago), insects with wings suddenly evolved. Flight first appears fully developed, and there are no intermediate forms. Pterosaurs appear in the late Triassic (225 million years ago), while birds (at least Archaeopteryx) appeared about 150 million years ago. Bats, a real bane for insects, appeared only 55 million years ago in the Eocene. Winged insects, appearing over 300 million years ago, were the undisputed masters of the air for a very long time.

A close relative of Sinornithosaurus could be a very strange-looking creature. *Beipiaosaurus inexpectus*, as the name suggests, was an unexpected find from Beipiao, in Liaoning Province, China. They look something like an ostrich, with a large head, robust legs, fearsome-looking arms, and a tail. This Middle Cretaceous creature is among the largest feathered dinosaurs; adults could be about 7 feet long and almost 3 feet tall and could weigh almost 200 pounds. The body was covered with downy feathers, similar to those of Sinosauropteryx. This suggests that they were theropod dinosaurs, although they were herbivorous, unlike typical theropods.

Lurking in the shadows of the diorama is a creature that looks something like an opossum, but it may have had a temper more like a Tasmanian devil. *Repenomamus giganticus* could likely make a quick sprint to catch food, but was unlikely to be able to run down prey over a long distance. It attained a maximum size of about 3 feet long and could weigh about 30 pounds. The animal lived in the Early Cretaceous period, about 130 million years ago, long before what is regarded as the age of mammals. This fossil suggests that some early mammals could have been large enough to pose a threat to dinosaurs. Baby dinosaurs of many species could be a meal, as could adults of some of the smaller, birdlike dinosaurs. Giganticus overturns the idea that early mammals were small and nocturnal, and only fed on insects.

The American Museum of Natural History Web site (www.amnh.org/exhibitions/dinosaurs/intro/) has a good introduction for those who later visit the exhibition that is also entertaining for those who cannot visit in person. There is a short video that outlines the main points of the exhibition, as well as a detailed introduction to the whole exhibition. Of particular interest is the detailed species list for the diorama.

Dinosaurs. Ancient Fossils. New Discoveries will be on display at the Field Museum in Chicago from Mar. 30, 2007 through Sept. 3, 2007. Get a preview of the exhibit and details about the museum on its Web site, www.fieldmuseum.org, or by calling (312) 922-9410.

Quartz Crystal Dig

Mount Ida's 20th Annual World's Championship Event

Story and Photos by Kenneth H. Rohn

After a rather humble beginning in Mount Ida, Arkansas, more than two decades ago, the World's Championship Quartz Crystal Dig has grown to gigantic proportions. During the middle of October each year, rockhounds from everywhere gather at the Montgomery County Fair Grounds to sign up for an exciting, adrenaline rushing, long weekend of world-class crystal digging.

The 2006 contest was sponsored by the Mount Ida Chamber of Commerce and the Mount Ida First National Bank. Three crystal mines—the Bear Mountain (Fiddlers Ridge), Sweet Surrender, and Arrowhead mines—were open only to contestants during the three-day event, which began on Thursday morning and ended Saturday afternoon.

Quartz clusters like this can be found in any of the mines that hosted the 2006 contest participants.

It all began 23 years ago, when three men had an idea. Having a good number of years of collecting experience behind them, they decided to organize a contest in which participants would go to a mine and dig for crystals. These wonderful gemstones would then be taken to the fairgrounds for judging by those three men.

Prizes were given out for the best specimens found during the dig. From the beginning, crystals were judged for quality, clarity, beauty, size, number of crystal points, and monetary value. All this took place during the County Fair, and it attracted quite a crowd of onlookers and rockhounds interested in collecting quartz crystals.

Needless to say, it was an enjoyable and exciting experience for all involved, so the men decided they'd do it again the following year. After a rousing success the second year, the Chamber of Commerce and various other businesses joined in to sponsor the third annual contest. It has been held as a completely separate event in the fall ever since. It coincides with two other exciting and interesting events the same weekend. Collectively, they are known as the Quartz, Quilts and Crafts Festival, held in three separate buildings on the Montgomery County Fair Grounds in Mount Ida.

In their free time, contestants and visitors can view the outstanding and breathtaking displays of gems, crystals and crafts from every corner of the country. Hot food is dispensed by the Lions Club every day in the Ode Maddox Building, which is also the dig headquarters.

Mount Ida is known as the Quartz Crystal Capital of the World, and anyone who has collected there will testify to the validity of that moniker. The surrounding mountains seem to be bursting with crystals and, strange as it may seem, that is actually where they are found—right at the summits of those peaks in the Ouachitas. They can be tiny, perfect jewels or crystals as large as an SUV. I once saw a crystal group hauled up from a deep mine in Jessieville that staggered the imagination. One point was taller than I, and I'm over 6 feet. Of course, it was milky and covered with iron oxide, but it had the typical, hexagonal crystal shape that terminated in a sharp point.

Arkansas scenery is out of this world, with panoramas of forested mountain peaks and pristine meadows bordered with pines and hardwoods. The air is fresh and pure, and after a day of digging in the mines, food never tasted better. Sleep comes easily and we awake refreshed, ready for another day of adventure.

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At some of the Ouachita Mountain mines, the crystals form in pockets in a limestone horizon, while at others they are found in granite and rhyolite horizons.

The contestants' freshly dug crystals are presented, uncleaned, for judging.

Some of the freshly dug quartz crystal clusters show a red coating of iron oxide.

Quartz Crystal Dig *from page 73*

I had been invited by the Mount Ida Chamber of Commerce to cover the 2006 World's Championship Quartz Crystal Dig. After an enjoyable drive from our home in Minnesota, my wife, Betty Carol, and I arrived at Mount Ida the day before the contest was to begin. The sun was setting below the Ouachita peaks when we found our way to the luxurious condominium cabin that was assigned to us at Mountain Harbor Resort. Our accommodations were compliments of the Mount Ida Chamber of Commerce and its Executive Director, Maureen Walther. Maureen is also the contest organizer and director of the Dig Committee, positions she has held for the past three years.

Mountain Harbor is a beautiful place, situated on the shore of Lake Ouachita. Betty Carol and I thoroughly enjoyed our stay there. We met and made friends with a great number of people. We also visited with old friends in the Mount Ida area during the weekend.

After a good night's sleep at the condominium, we found Maureen at the Ode Maddox Building the morning of the first day's dig. It was sign-up morning and the building was a flurry of activity. Contest officials and contestants kept Maureen very busy with questions and details of the event. She had an answer for everyone's problems, and she gave it with a smile. She is a most charismatic person, and we liked her instantly.

I looked around to see if I recognized anyone. The huge building was overflowing with people. All the chairs were occupied, and people stood in groups visiting or waited in line at the sign-up table or the food counter.

Each day of the dig, Betty Carol and I had the privilege of observing the event firsthand at all three mines. It was very difficult to simply stand and watch the contestants digging for those beautiful crystals as a reporter for the dig, I could not participate, but I had a wonderful time simply observing the activity. Betty Carol relinquished her opportunity to enter the contest so that she could help me.

The contest is open to everyone, from anywhere in the world, who has the desire to dig his very own magnificent quartz rock crystals and compete for prize money and trophies. Children ages 10 to 16 may compete in the adult contest with supervision. Not only does everyone have a chance at winning a trophy, they can keep everything they recover from the mines, and the crystals coming from all three mines are masterpieces of nature.

Collecting crystals in the mines alone is well worth the effort. These gemstones, created during the violent formative epochs of our Earth, will not only add beauty, but much value to anyone's collection of minerals.

On Sunday, a special children's dig was conducted in the field behind the fairground buildings. The kids had a ball rummaging through a huge pile of mine run material. Betty Carol and I watched and took photos of the event. I think we had almost as much fun as the contestants.

Prize winners get to take home cash as well as an assortment of fine quartz crystals.

Addie McDaniel and Grayson Abner dig through a huge pile of mine run material for quartz crystals placed there by the contest organizer.

Maureen, who was conducting the contest, had the children turn their backs while she buried gem-quality crystals painted with red tips in the pile at random. We watched as the next generation of rockhounds scrambled over the pile of red dirt, digging furiously, searching for a prize crystal. All of the crystals were found after a great deal of earth moving by the girls and boys.

Betty Carol particularly enjoyed the quilt display in the neighboring building, and during our lunch breaks and whenever she could, she went over to admire the wonderful and colorful quilts. They filled the entire building from wall to wall. She even managed to talk me into going over one day. I was impressed with the beautiful artwork of those ladies.

There was a daily drawing for prizes, which Betty Carol and I somehow missed. There were so many other things going on at the mines that we often arrived late at the Ode Maddox Building.

During the course of the event, Betty Carol and I met and talked with the judges of the contest. They were Carla Rose, O. "Sonny" Stanley, and Barry Walther. The guest of honor was Arkansas State Geologist Mike Howard.

I also had the privilege and honor of meeting and talking with O. "Sonny" Stanley, one of the three original contest organizers. He has been on the judging committee ever since the beginning. I sat down one afternoon with Sonny, who was overseeing the rifle raffle table for the Lions Club. This was but one of the many duties he performed during the contest.

Sonny is a most likable man with an unlimited knowledge of quartz crystals and crystal mining. We talked about the fascinating and engrossing hobby of mineral collecting in general. I asked Sonny how they judge the numerous crystals that are presented at the contest each day. He said it is often quite difficult to determine which are the best ones. It takes quite a bit of evaluation by the three judges to arrive at a fair assessment.

Sonny also told me that the contestants' crystals cannot be cleaned. They must be handed over to the Dig Master at each mine at the end of the day (3 p.m.) just as they are found. This person will take them, in a specially numbered bag, to the Ode Maddox Building for judging. The contestants won't see them again until the last day of the contest, when their crystals will be returned to them. The winning points and clusters are recorded on the board on the stage each day. It was an enlightening conversation.

The contestants could choose which mine they wanted to dig in for the day, and the rules stated that they must stay in that mine during the hours allotted. They were allowed to choose a different mine each day of the contest if they desired.

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The Bear Mountain Mine is owned and operated by Jim and Kathy Fecho. The Fechos, along with their son Bobby, took time out from their duties to show us around their mine and explain what one can expect to find. We saw some very impressive examples taken out of the ground by the many contestants. Kathy was the 2006 Dig Master for Bear Mountain Mine.

Bobby climbed a rather high bank and worked on a crystal pocket for our benefit. While opening it up, he gently extracted several crystal groups. He explained what one looks for and what can be found in their mine. He handed down one cluster that was covered in sticky, red pegmatite clay. I could see several perfect, exposed points in the group. The crystals coming out of that pocket were phenomenal.

Mathew Price owns and manages the Arrowhead Mine. We met Mathew at the mine entrance and explained why we were there. He cordially invited us to his mine, pointed out the different sections of the pit, and explained how to get there. It's a huge mine situated right at the summit of a mountain peak. Betty Carol and I watched from several vantage points above as many contestants, young and older, worked at digging crystals. We walked down into the mine and watched the diggers work close-up. Everyone was having a great time. We watched as one outstanding cluster on a large matrix of granite was removed from a pocket. It would, without a doubt, gladden the heart of even the most finicky collector. It was magnificent, with several perfect points on an almost flat block of matrix.

The Sweet Surrender Mine is owned by Randy Skates, assisted by his girlfriend, Becky Young, and helper Wes Gibbs. Randy, Becky and Wes were most hospitable and spent a good deal of time with us, explaining the formations of the mine and where one might find pockets of crystals. Randy and I talked about his mine and their plans for the future. He expects that the deeper he digs, the larger the crystals will be. At the present time, the mine is yielding some very beautiful quartz crystals. Kathy walked with me down to the lower level of the mine where three contestants were just opening up a fantastic pocket. They were carefully working a group of crystals loose when I arrived at the scene. Although I didn't want to interfere, they allowed me to take a few photos of one cluster that was exposed, but not yet removed. One crystal point had to be at least 7 inches long and about 1½ inches in diameter!

Surprisingly, these mines are not that far away from one another; in fact, two of them are possibly only six miles apart as the crow flies; yet each one is different from the others. In one respect, however, they are similar. They are all situated on Ouachita mountain peaks. The difference is that one mine will have schists and crystal-containing pockets situated in a limestone horizon, while the others are found in granite and rhyolite horizons.

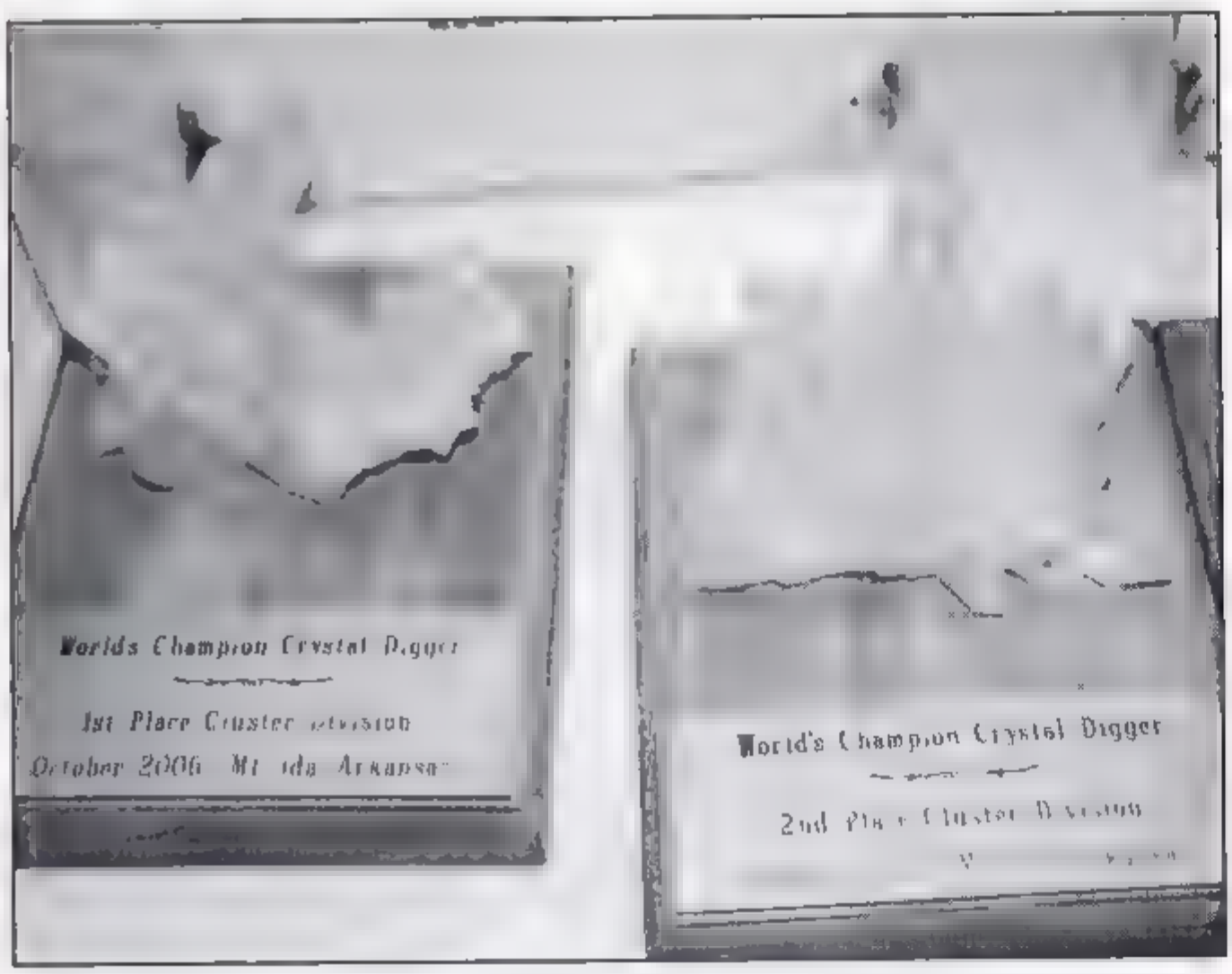
Despite these differences, the quartz crystals coming out of all three mines, for all intents and purposes, are the same. They all have the same chemical composition and coloration. They can be found in all three mines, with a coating of very black manganese on some crystals and red iron oxide on many others. A few have colorful inclusions in them. Many crystals are doubly terminated. Some come out of the ground pristine and water clear, with very few imperfections. They remind me of the famous "Herkimer diamonds," small, water-clear quartz crystals found in New York, and are equally beautiful.

The digger who accumulated the largest number of points (not crystal points) during the three-day dig was the winner in one of two categories: best point and best cluster. Other prizes were given to second-, third-, fourth- and fifth-place winners for those categories, as well. The 2006 prize money was donated by the First National Bank of Mount Ida.

At 6 p.m. Saturday evening, Betty Carol and I were on hand to observe and photograph the awards ceremony. It was quite exciting. I stood on stage and took photos of the winners as they were given their prizes. The first-place winner in each category received $250 cash, plus a crystal trophy; the second-place winner, $200 cash and a crystal trophy; third place, $150 cash; fourth place, $100 cash; and fifth place, $50 cash. All those outstanding crystal trophies were mounted on beautiful wooden plaques and donated by the three mine owners.

For all of us who are enamored by rocks and gemstones, Mount Ida should be No. 1 on a list of vacation stops. If you enter this year's contest, you could go home with a great collection of those wonderful quartz crystals, and if fate smiles upon you, some prize money could help pay for your vacation. When digging for crystals in the Ouachita Mountains, everyone is a winner.

For information on the October 2007 contest, visit the Mount Ida Chamber of Commerce Web site, www.mtidachamber.com, e-mail director@mtidachamber.com, write to Mount Ida Chamber of Commerce, PO Box 6, Mount Ida, AR 71957, or call (870) 867-2723.



First- and second-place winners in each category receive outstanding crystal trophies, mounted on beautiful wooden plaques and donated by the three mine owners.

Rock Science

by Steve Voynick

Tourmaline's Electric Properties

Tourmaline's popularity as a gem stone is based on its respectable hardness (Mohs 7.0 to 7.5), durability, and range of colors, which are among the most subtle and exquisite in the mineral kingdom. The name "tourmaline" refers not to a specific mineral, but to a mineral group that includes 11 distinct species and 29 varieties. All are basic borosilicates of such metals as sodium, calcium, lithium, magnesium, aluminum, iron, and manganese.

Some of tourmaline's most interesting features, namely its pyroelectrical and piezoelectrical properties, can only be detected with electrical instrumentation. Pyroelectricity (from the Greek *pyr*, for "fire") refers to voltage generated by heat, while piezoelectricity (from the Greek *piezein*, "to press") is voltage generated by pressure.

Tourmaline's pyroelectrical properties have been known since Greco-Roman times, when heated tourmaline crystals were observed to attract dust particles. In 1703, the Dutch first utilized tourmaline's pyroelectrical properties, then thought to be a form of magnetism, by using heated crystals, called *ashentrekkeren* ("ash drawers") to extract ashes from tobacco pipes.

By the early 1800s, researchers had learned that heating tourmaline produced a positive electrical charge at one end of the crystal and a negative charge at the other end, and that these charges reversed themselves when the crystals cooled.

British physicist William Thomson (Lord Kelvin) published the first theoretical treatment of pyroelectricity in 1878. Working with quartz, he noted an "electrocaloric" effect in which crystals seemed to generate disproportionate amounts of electrical current with higher levels of heating.

But French researchers Jacques and Pierre Curie challenged Thomson's electrocaloric theory. Also working with quartz, the Curies proposed instead that the disproportionate amount of current generated by higher heating was actually caused by pressure, and described both "true" and "false" pyroelectricity. They determined that "false" pyroelectricity was caused by mechanical stresses induced by thermal expansion and contraction, rather than by heat itself, an idea that led to the discovery of piezoelectricity.

Other researchers learned that tourmaline-group minerals had far greater pyroelectrical and piezoelectrical properties than quartz. But the exact causes of both phenomena eluded researchers until the 1920s, when newly developed X-ray diffraction techniques began helping to unravel the mysteries of crystal-lattice structure.

The tourmaline-group minerals are silicates, in which the basic structural unit is the silica tetrahedron. These tetrahedra join together into seven different silicate structures, the general configurations of which are apparent in their names: single- and double-chain silicates, sheet silicates, double-tetrahedral silicates, ring silicates, etc.

The tourmaline-group minerals are ring silicates (cyclosilicates), in which silica tetrahedra are bound together in closed rings. This provides strength and rigidity, while giving tourmaline great spatial stability, meaning it expands and contracts very little when heated. Tourmaline's rigid ring structure also explains its extraordinary pyroelectrical and piezoelectrical properties.

When tourmaline is heated, the thermal energy causes only minimal mechanical distortion, and instead energizes ions and displaces them from their normal positions in the crystal lattice. Due to the repetitive nature of the crystal structure, ionic displacement accumulates until an opposing electrical potential (pyroelectricity) builds up on certain crystal faces.

In piezoelectricity, the input of mechanical energy also only minimally deforms the ring structure. The excess energy, however, displaces ions from their normal positions, thus essentially transforming mechanical energy into electrical energy.

By World War II, tourmaline crystals had become the standard sensor for pressure gauges, most notably in the very specialized instruments built into the hulls of submarines.

During the post-war technological boom, tourmaline's piezoelectrical properties were applied to everything from phonograph record pickup sensors and microphones to transducers, oscillators and amplifiers.

FIELD TRIP

Elusive Elbaite

Hunting for Tourmaline on Elba Island, Italy

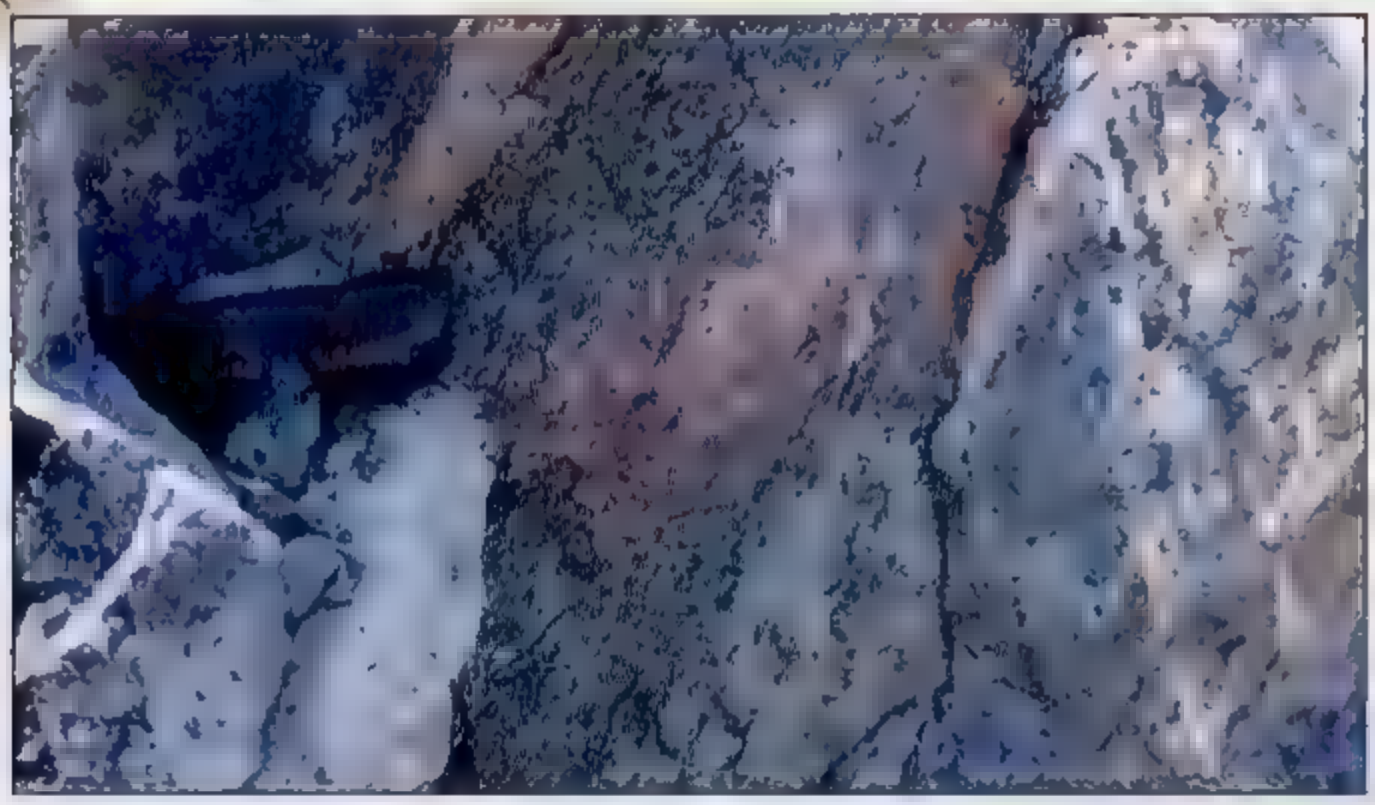
Story and Photos by Robert Beard

The idea behind our collecting trip to Elba Island in Italy formed in a very unusual setting. In early May 2005, I was in northeastern Wisconsin on a tourmaline-collecting trip. The snow had just melted, and I was fighting my way through dense briars growing out of Precambrian gneisses in Nicolet National Forest. I was searching for an outcrop that reportedly had pink elbaite, and I was becoming very discouraged. The only unusual thing I had seen so far was a porcupine, and the few outcrops I had found were barren of minerals other than quartz and hornblende.

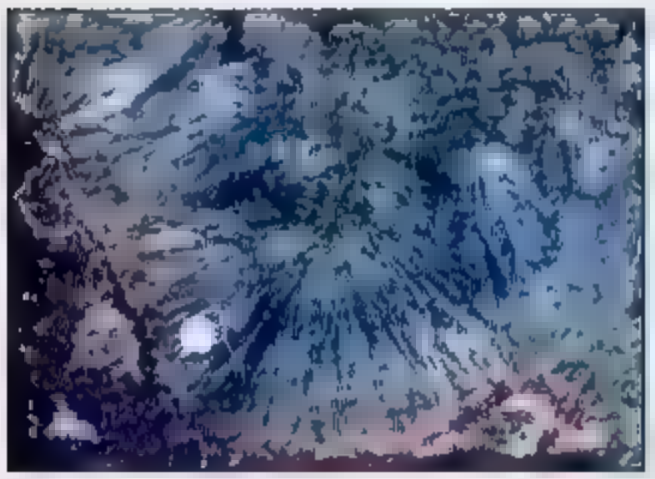
I had previously hunted for elbaite tourmaline in New Hampshire and Maine, and had never met with success. It is one of the most elusive minerals I have ever searched for. It seemed like the

The beach at Capo Bianco (Le Ghiaie) is not sand, but white aplite pebbles with tourmaline. The fort in the background was built by the Medici during the 16th to 18th centuries.

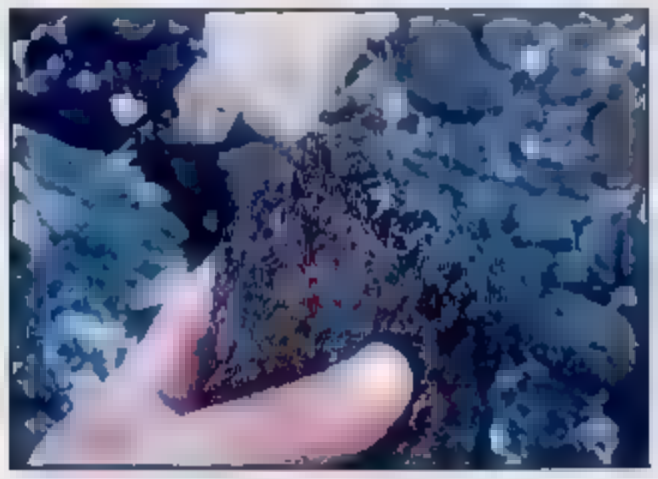
The tourmaline gives some of the pebbles orbicular features.



In the road cuts along the road between San Ilario in Campo and La Pila, orange, bubbly agate coats some of the rocks.



The hedenbergite crystal clusters are quite striking when seen up close.



The hematite/magnetite rocks often exhibit bladed crystals on broken surfaces.

closest I could get to elbaite was in museums and image searches on the Internet.

It was cold, I could not find any more outcrops, and I soon had to call it quits. Darkness was about to fall, and I could feel the temperature plummet. Biting cold seeped through my layers of clothes. I returned to my car without any elbaite, but if nothing else, this trip strengthened my resolve to find elbaite tourmaline, wherever it might be.

After I returned home to Pennsylvania, I continued my research into elbaite. Previously, I had never given much thought to the name elbaite, but I did notice that the mineral was found worldwide. Elbaite is a rare, lithium-bearing, light-colored tourmaline that occurs in shades of green, yellow, red-pink, and blue. It is among the most beautiful and valuable of the semiprecious gemstones.

I later learned that it was named after the Italian island of Elba, which is located just off the west coast of Italy. Coincidentally, my wife and I were planning a trip to Europe during the summer of 2006, and I was looking for potential collecting sites to visit during our trip. Could it be possible to travel to Elba Island and come back with some elbaite?

We were going to Europe as my wife, Rosanna, was assisting with the establishment of a summer program for Harrisburg Area Community College in Oviedo, Spain. We had two weeks to spend overseas, and had to pick where to go once we had taken care of her business in Oviedo. Based on my atlas, it seemed reasonable to get to Elba, spend some time there and elsewhere in Italy, and make it back to Oviedo in time to catch our return flight home.

I made reservations at the Hotel Da Fine (www.hoteldafine.it) in Seccheto, Elba, over the Internet, and now we just had to figure out how to get to Elba. Since we were also sightseeing, I opted for a Eurail pass to get from Oviedo to Italy. This had to be purchased prior to our trip, as it cannot be purchased in Europe.

I read everything that I could find on Elba Island and its potential collecting sites during spring 2006. My main source of information was No. 8 in the extraLapis English series, *The Italian Island of Elba: A Mineralogical Jewel in the Tuscan Archipelago*, by Federico Pezzotta (Lapis International LLC, October 2005).

Elba Island is one of the oldest centers of mining in the world, and was a major source of copper and iron, as well as tourmaline. The mines have been worked for over 3,000 years. The island is only about 18 miles long by three to six miles wide, and produced copper, iron and gems in amounts that far exceed what one might expect for such a small island.

Elba was originally occupied by the Ligurians, who were the first to mine the copper and iron deposits. They were followed by the Etruscans, who mined the deposits until the Romans took over around 400 to 300 B.C. The island had one of the world's first environmental laws; the Romans soon prohibited further forest cutting to produce fuel and charcoal for the iron forges on Elba. Like many modern environmental laws, this soon put the island into decline with respect to iron production and its economy, but it helped preserve the remaining trees.

The island is perhaps best known for Napoleon's rule there from 1814 to 1815. The island actually became part of modern pop culture with a brief but important role in the opening scenes of the recent remake of "The Count of Monte Cristo." The island benefited from Napoleon in the development of roads, water supply, and mining, but Napoleon left before many of his plans were finished. The island later became part of Italy and was occupied briefly by the Germans during World War II. Postwar, the island positioned itself to focus on mining, wine making, and tourism. The last iron mine closed in 1980, but fortunately the island still produces wine, and tourism is by far the driving force of its economy.

The western side of Elba is mostly granitic rocks and pegmatites, while the eastern side is mainly sediments, igneous rocks, serpentines, and skarns. The pegmatites from the western half of the island host the gem-quality elbaite, while the eastern half has the iron mines. The copper mines are mainly in the southeast corner of the island. The mines were the source of much iron and copper to the ancient world, and the iron mines later supplied European industry for much of the 19th and 20th centuries.

Our trip from Oviedo, Spain, to Elba Island was a long and sometimes stressful trip. Traveling by train through Europe is great, but I had forgotten how long it took to travel from place to place. I had brought several books and read nearly all of them. Since we had a Eurail pass, we did not have to pay for each train, but often had to pay for reservations and overnight trains. However, the scenery and the opportunity to visit different cities along the way made for an interesting trip.

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We had an overnight stop in Barcelona, Spain, caught the evening train to Milan, which we left in Torino, and then rode the morning train to Rome, which stopped in Campiglia. There was then a short, direct train to Piombino, Italy, which was the embarkation point for the ferry to Elba Island The most stressful part was that we had to catch every train on time, or else we would not make it to Elba in time to get our car and our paid hotel Piombino is a very industrial city, and the port and the mills were undoubtedly fed by many of the iron mines from Elba

Fortunately, we made all the right decisions and got to Elba's main city, Portoferraio, by early evening The rental car place, TWN Rentals (www.twn-rent.it) closed at 7 p.m. and we arrived at about 7:15 p.m. Fortunately, however, the owner had stayed open and had one last car for us. Apparently, my reservation had not been confirmed, and we nearly missed getting a car The owner, who fortunately spoke English, was extremely helpful and hooked us up with a Panda, a small Italian car

It was really important that we got a car, as I did not have an appreciation for the size of Elba Island Elba, while it is small compared to Corsica or Sicily, is quite large and takes a long time to get around Had we rented a taxi, it would have been very expensive Driving is challenging, but at least they drive on the right, which was helpful Scooters are very common, and the riders are crazy I would never recommend renting a scooter unless you are an expert rider. Fortunately, we arrived at our hotel without incident

The Hotel Da Pine had our reservation, and we arrived late that evening Seccheto is a town on the southwestern side of the island and in the granitic rocks. We walked down to the beach, and as a geologist, I noticed right away that we were in a massive complex of granite. Rounded granitic boulders with migmatitic gneisses and small pegmatites lined the sides of the beach

Based on my research, I knew where the most likely collecting sites would be If we were to find pegmatites, they would be on the western side of the island, and the iron mines would be on the eastern side of the island. Unfortunately, this was also a foreign country, and we had to be extremely careful about property access. I did not know anyone on the island who could give us access to the pegmatite mines, and without speaking Italian it was nearly impossible to ask permission. I thought the best thing to do was to drive and watch for outcrops and signs of collecting sites.

The beaches at Terranera have huge boulders of hematite and magnetite.

The black beach sand at Terranera is extremely dense, and much of it is magnetic.

Based on my previous experience with hunting tourmaline in the United States, I also wanted to make sure that we did not burn up all of our time chasing minerals that we may not find To put things in perspective, I knew that people had been hunting tourmalines for thousands of years on this island, so the likelihood of stumbling onto a tourmaline-bearing site was not good Therefore, our plan was to scout out the likely tourmaline areas, and if they did not produce results, we would then go to the eastern side of the island where the collecting would likely be very good for many other minerals.

We left Seccheto and drove east toward Marina di Campo. The traffic was surprisingly heavy, and we did not see any signs of any potential pegmatite sites. There were no places to pull off on the highway, so we continued toward the eastern end of the island.

The geology changed considerably as we went from west to east. Just east of the town of Lacona, we found a pull-off, and I found that the rocks in the road outcrop were slickensides of heavy, dark-green serpentine We eventually made it to Rio Marina, which was the site of some of the major iron mines on the island. On the north side of the town, we saw a former ore-shipping terminal, and we found a small, unpaved parking lot that was near one of the former mines. Here we found some nice hematite boulders and more pieces of serpentine.

We continued north on the road, which roughly paralleled the coast of northeast Elba. We soon found a road that turned to the east and got us to the shore The road sign indicated that this was Le Fornacelle, and there was a pizzeria by the same name on the beach I thought that we could likely find an abundance of rock on the shoreline Sure enough, the beach was covered with large, multicolored rocks. The manager of the Le Fornacelle restaurant said it was fine to collect rocks along this shore

The beach, which was extremely rocky, was a fascinating place for collecting We were in the iron region of Elba, and the rocks were a mix of hematite, magnetite, and orange aragonite While searching for rocks, we met a German family that had been coming to Elba for many years. The daughter was collecting small orange crystals of aragonite, and the mother and father had collected large orange pieces of travertine and aragonite with radiating crystals. They had quite an advantage

over us, however, as they had their car and were driving back to Germany; we were limited by what we could carry back on our return flight. Their car was loaded with huge pieces of travertine and hematite. It convinced me that rockhounds must be the same the world over: we tend to fill up whatever space we have to carry rocks.

On the way back to our hotel, we stopped by the shipping terminal just north of Rio Marina. Despite the industrial history of the area, there were still many people using the beach. Huge boulders of serpentine, hematite, magnetite, travertine, and quartz with pyrite lined the cliffs. It was very easy to find bladed hematite, and many of the yellow boulders had sections with well-formed pyrite crystals. I was able to break off some nice pieces, and would have collected more if I'd had more space for packing.

On our way back we stopped in Rio Marina to look for a reported outcrop of hedenbergite. According to *Island of Elba*, this outcrop was located on the south side of town by Torre de Rio. We found it by walking to the base of the cliffs south of town along the water. The outcrop has huge radiating masses of hedenbergite up to about 20 centimeters wide, and they are quite spectacular. However, there were no loose pieces for collecting, and it was obvious that one could get into a lot of trouble by hammering away at this outcrop. A family was fishing next to the rocks, but even if they were not there I would not try to take any pieces.

The following day, we made another attempt to find a pegmatite outcrop. This time we went by San Piero in Campo, on a winding mountain road. Our rental car was a "stick shift" and was able to easily handle the climb, but I had a feeling that these rentals had high maintenance bills. It was extremely difficult to find places to pull off that were in the reported zones of pegmatites. We finally stopped at a location above some steep switchbacks and just west of La Pila, where we saw some outcrops. From this area we had an excellent view of Monte Capanne, which is the highest point in western Elba.

I was uncomfortable taking my hammer, as I was unsure of the collecting and land status. I walked along the outcrops looking for pegmatitic zones. The granitic rocks were weathered, and I did not see any pegmatites, but I found some interesting crusts of orange chalcedony. Much of this was quite bubbly, and I broke off some of the better pieces by hand. We later investigated some additional outcrops along the switchbacks on the way down the hill to La Pila, but did not see any more agate. At this point, we pretty much gave up on finding elbaite, but we had one more potential site at which to find tourmaline.

We drove to the main town of Portoferraio. Our main goal was to get to Capo Bianco (White Cape) Beach. This beach is also known as Le Ghiaie. According to *Island of Elba*, the beach at Capo Bianco is white aplite pebbles with dark tourmaline spots. According to legend, when Jason and the Argonauts stopped on Elba, their sweat dirtied the pebbles and gave them their spots. I thought that if we could not find elbaite tourmaline, at least we could get some interesting dark tourmaline.

The beach was easy to find, as it was clearly marked on the maps. It was extremely crowded, and we had to park quite a ways up the hill from the beach. There were the usual "No Fishing" and "No Littering" warnings on the, but nothing about rock collecting, so we figured it would be fine to collect some of the aplite-tourmaline pebbles.

The cliffs at Capo Bianco are quite large and bright white. They resemble marble cliffs, but aplite has a composition similar to granite, though it is very fine-grained. The beach has billions and billions of the pebbles. The tourmaline ranges from black to dark brown to dark blue, and some of the pieces actually resemble eyes. The spots may be less than ¼ inch in diameter, while some pebbles are almost all tourmaline.

The actual origin of the tourmaline spots is not as colorful as legend has it. The aplite was enriched in boron, aluminum and water, and this led to the formation of the tourmaline. The black tourmaline, known as schorl, is iron-bearing, while the brown tourmaline, known as dravite, is magnesium-bearing. Tourmaline also is strongly pleochroic, which means that the color can vary as the mineral is viewed from different directions. This is best observed in thin section, but the spots on the pebbles we found seemed to exhibit this quality. They were scattered throughout the rock and oriented in many different directions. You could not see the change in color by turning the rock, but it was certainly apparent that the tourmaline color varied in some of the pieces, and I suspected that this was due to the pleochroism of the tourmaline.

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Interestingly, there was a Sept. 7, 2006 article in the news section of www.Discovery.com by Rossella Lorenzi entitled "Italian Sand Burgled by the Bucketful." The writer describes how collectors are stealing the sand from beaches in Italy. The author stated that "In the island of Elba, most of the speckled pebbles of the Ghiaie beach near the village of Portoferraio are gone." Although we visited Ghiaie in July 2006, which was just before this article is dated, I believe that this article was not correct and is very misleading. It might be possible to remove the pebbles by a large-scale industrial operation, but there is no way that beachgoers have removed the hundreds of thousands of tons of spotted aplite pebbles on this beach. And frankly, most beachgoers in Elba are more interested in sunning themselves than in collecting dirty pebbles.

We later drove to the western side of Capo Bianco, which also has a long beach and a much better parking area. This was slightly less crowded, and it was possible to get a close-up view of the cliffs. It looks as though the cliffs have been sprayed with drops of ink, and in some cases the masses of tourmaline were several inches across.

Afterward, we decided to try to find and visit a local rock shop. I was somewhat surprised that we did not see more rock shops, given the significance of Elba to tourmaline. During our trip back from Rio Marina, we saw a place in Porto Azzurro that had a rock shop and museum. This was La Piccola Miniera (The Little Mine), and we stopped in for a brief visit.

This shop offered a mine tour, but it was a replica tour and not a real mine. They had built a small tunnel with a mine train track. We were the only ones on the tour, and fortunately they had an English narration tape, as our train operator did not speak English. The narrator spoke with a British accent. The mine showed how a representative underground iron mine operated on the eastern side of Elba. Much of the technology was similar to that of underground mines in the United States, but the example miner's lunch was much better, as it included a jug of wine. They did a very nice job of building a replica mine, and is has the advantage of being dry and right on the site.

The most interesting thing about this tour was the museum, which had gigantic specimens of pyrite, calcite, quartz, hematite, magnetite, and other minerals that had been extracted from the iron and copper mines. Interestingly, I did not see any elbaite tourmaline on display. There was only one person who spoke English at the mine tour/museum, and she did not know anything about elbaite. I do not recall seeing any for sale in the gift shop. Apparently, elbaite was much harder to find than I thought, even on Elba Island.

After the visit to La Piccola Miniera, we went south to a place suggested to us by the German family we had met the previous day. Terranera was the site of a large iron mine, and we were told that the beaches were of black sand. This area is on the southeast coast of Elba, and fortunately we found the place relatively easily. The beaches were next to several small cliffs, and as we followed a path toward the iron mines, we soon came to a sign that said, in no uncertain terms, to keep out. I figured this was the last part of our trip.

The beaches at Rio Marina are loaded with huge boulders of quartz with pyrite, hematite and magnetite, serpentine, and many other rocks and minerals.

However, we then saw several people, including families with small children, walking right through the mine area. We followed, and soon came to the beach area. There were many people on the black sand beach. A huge concrete structure that was part of the former mining operation was also on the beach.

The black sand was unlike the typical fine black sands I had seen in other beaches. This was coarse, metallic hematite and magnetite. You could feel the denseness of the iron when you grabbed a handful. Interestingly, even though the beach was covered with the remnants of mining, the water seemed very clean and unpolluted.

We found some large hematite-magnetite boulders on the beach, and these were loaded with shiny specular hematite. A pond, which appeared to be a former tailings pond, was nearby, surrounded by fencing. There were several interesting outcrops with hematite mineralization, but many of these were very weathered. The best place to see the hematite and magnetite was in the rocks and boulders on the beach.

The biggest problem with collecting on a trip that requires a return by air is that you are limited by the amount you can carry back. On our Elba trip, we also had to carry whatever we took with us back on the train though Europe. I carefully trimmed pieces and left several rocks that I did not want to carry home in the parking area of our hotel. After we left Elba, we took the train to Rome, but on our return trip to Spain, we took the ferry back to Barcelona instead of another overnight train from Torino. The ferry, while more expensive, was more like a cruise ship and far more relaxing than the overnight train.

We still had quite a bit more time to spend in Europe, and carried our Elba rocks with us the rest of the way. Our bags were at the maximum weight allowed when we flew back to the United States, but fortunately there were no problems with carrying out so many rocks. That September, I used the rocks for our display at the Central Pennsylvania Rock & Mineral Club's annual show. The minerals we collected now occupy a key part of my home museum.

Although we did not find the elusive elbaite tourmaline, we still found many unique minerals on Elba. The schorl and dravite tourmalines from Capo Bianco were a very nice prize, and I especially enjoyed finding the bladed hematites and well-crystallized orange aragonites. Elba is an excellent place to visit, even if only for a brief time, if you ever have the opportunity to go to Italy. To get to Elba, you will have to take the ferry from Piombino, unless you fly to Elba directly. I would not recommend getting a Eurail pass unless you plan to take the train elsewhere through Europe. In hindsight, I think it may have been cheaper to just buy tickets for each train trip instead of getting a pass. Fortunately, train travel in Italy is very cheap. You will definitely need a car in Elba, and unless you speak Italian or German you must be prepared to deal with a situation in which hardly anyone speaks English. However, the people are friendly, and it is a very safe place to visit. The island offers some very unique collecting opportunities and is well worth the trip.

FIELD TRIP

Treasure State Adventures

Part IV: Collecting at Fabulous Crystal Park

Story and Photos by Kenneth H. Rohn

This water-clear point shows fractures at the base, where it was broken from a pocket wall.

After two great days of collecting almandine garnets at Ruby Reservoir, I drove over to the Pioneer Mountains northwest of Dillon, Montana. I took the Pioneer Scenic Byway in Beaverhead National Forest to Crystal Park, my destination for this field trip. This beautiful drive can be reached by going west of Dillon on state Route 276 (the southern end of the byway). If you are coming from the north, you can enter the byway at the community of Wise River, on state Route 43. Crystal Park is situated approximately halfway along the route.

Gem-grade quartz crystals in a variety of sizes and shapes can be found at Crystal Park.

Crystal Park is, as its name implies, a mountain peak that is actually littered with gleaming quartz and amethyst crystals. I would class it as a "rockhound paradise," bar none. At the time of this writing, the collecting fee is $5 per day. Visitors can dig any amount of crystals that their stamina allows. The holes dug to recover crystals must not undermine trees. So long as they heed the rules, keep the area clean, and respect the mountain, rockhounds will be allowed to continue collecting here indefinitely.

The Butte (Montana) Mineral Club holds mineral claims here totaling 40 acres, and the park is supervised by the U.S. Forest Service. Through their joint generosity, the park is open to the public for collecting magnificent quartz and amethyst crystals.

On the way north along the Pioneer Scenic Byway, I encountered roadwork on a grand scale. Workers were widening and improving the road for several miles south of the park; by the time you read this, it will have been finished. I approached a stoplight on this mountain road and was told by a highway worker that I'd have to wait at least 15 minutes for the pilot car. This gave me time to reload my camera and relax a bit. I'd used up a roll of 35 mm film on pictures of the scenery along the byway.

This wonderful cabinet specimen has a doubly terminated crystal cemented horizontally onto it.

The pilot car arrived much sooner than I had anticipated, and we took off at a leisurely pace on the detour. I was turned loose about two miles south of Crystal Park, where the construction ended.

It was late afternoon when I arrived at the park. The sun was hidden by a large cloud bank and would soon slip below the far mountain range. I fixed my evening meal and sat down to eat. Having a self-contained camper has its advantages. I had a great view from my picture window of the surroundings, and parked in the midst of a pine forest, it was almost like home.

After my meal, I took a walk on the paved trail that circles the claim. It was cool enough here in the higher altitude to wear a jacket. During my walk, I talked with a few other people. When I asked them how they were doing, one man proudly took a huge, twinned amethyst crystal from his pocket and held it out to me. He smiled when he told me that it had only taken him two hours of digging to find it. It was about 3 inches long, and the twins were at least 1½ inches wide. This was all the incentive I needed. I had the urge to start digging right then and there, but the light was already beginning to fade, so it would have to wait till the morning.

While on the trail, I saw evidence that countless people had spent untold hours digging holes. Holes are everywhere, even in the restricted places. I talked with the congenial ranger in charge. He said there are always the very few who tend to bend the rules to suit themselves. There's actually not much one can do about it unless they are caught in the act. One ranger, no matter how conscientious he or she may be, cannot stand guard over the park at all times. The longer everybody adheres to the rules, the longer we'll be able to collect those wonderful crystals here.

It felt good to stretch my legs after a long drive. Although I tired easily from the altitude and thin air, I enjoyed the walk around the perimeter of the peak. One sign near the summit gave the elevation as 7,717 feet above sea level. By comparison, I live in an area that has an altitude of 1,400 feet above sea level. It does make a difference.

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The mountains here in Beaverhead National Forest are home to a vast number of lodgepole pines. Some areas of the peak are closed to digging due to the fact that the trees are growing so close together it's impractical and unsafe to try and dig holes. I followed the trail ever higher. The grade is gradual and this makes for rather easy handicapped access. A wheelchair can be pushed here without too much difficulty.

It was almost dark when I returned to the camper. I began to feel the effects of a busy day on the road. It was time to settle in. If you are camping, there are two campgrounds not too far away from the park. There's also a motel/restaurant south of Crystal Park on the byway.

The sun hadn't yet risen over the eastern mountain range when I gathered my gear and made the trek up the mountainside. It was a cold morning. The day before, I had been at a much lower elevation, and the temperature had reached a high of near 80. This morning, I saw places where the ground was white with frost.

Since I intended to stay on the mountain most of the day, I made myself a lunch and took my camera and digging equipment and several zip-lock bags in which to carry any crystals that I might find. My tools included my folding shovel, my large ¼-inch screen, a 5-gallon plastic bucket, and a pair of cotton work gloves. It was cool enough to wear the gloves and my light jacket on the way up. I was wearing my grubbies for this outing, expecting to get a bit soiled working at the claim. I like to wear a pair of high-top (8-inch) leather work shoes. They're comfortable and help support my ankles while walking over rough terrain. There's no need to pound on rocks here, but a good pair of plastic glasses or goggles always helps protect those precious eyes from flying projectiles.

The dirt on this crystal-laden mountain is a rather coarse gravel, intermingled with a fine, light-brown clay. When dry, it's the consistency of face powder; it could be a problem when wet. The crystals are found by digging a hole. In that hole, if we are lucky, we'll sometimes break into a pocket that contains what we're looking for: wonderful, clear crystals. New holes are not often dug due to the fact that myriad holes are already started. Of course, if you desire to explore new ground and begin your own hole, there are few restrictions, so long as you stay a reasonable distance away from any trees.

The town of Bannack, Montana, west of Dillon, is one of the best-preserved ghost towns remaining in the state today.

I simply picked a likely-looking hole and began to dig and screen material. The trick here is to break into a pocket. I noticed, after working for about an hour, that the material with substantially more crystals in it was a rusty red color due to iron oxide. This was not consistent, but it averaged out on the high side. Almost every screen load, containing four or five shovelfuls of dirt, resulted in finding a few points in the screen.

I was beginning to warm up and had removed my jacket as the sun gained altitude over the mountain. I had actually begun to perspire before realizing how warm it was getting. It was around this time that I broke into a small pocket. I was excited to see what the screen held when I shook out the rusty-colored gravel. The first screen load out of the pocket produced a lovely cabinet specimen. It's unbroken and beautifully shaped, with a group of crystals resting on a narrow matrix that is almost perfectly flat. It measures 2¼ inches by 1⅜ inches, with the tallest water-clear point being 1¼ inches long and ⅜ inch in diameter. In all, there are nine crystals in the group. One doubly terminated and firmly cemented crystal rests on the matrix in a horizontal position. It really enhances the piece.

Since the air is thin at 7,000 feet, I had to take frequent rest breaks. I was having an exciting time discovering what each shovelful held when I screened it. It gets a bit contagious after the first gem-quality crystals appear in the screen. I was soon finding as many as five points in each screen load; some areas of the hole were more prolific than others. The hole was already 7 feet in diameter and 3 feet deep when I began digging. As the day wore on, it got a bit deeper and wider as I explored new areas in which to dig.

While working in the hole, I tried to keep some order by filling a depression nearby with the screened material. I began to feel hungry and realized that it was past noon. I had been so engrossed in digging and screening that I had lost all track of time. I found a flat rock and sat down to eat my sandwich. The park scenery is out of this world. Many mountain peaks surround Crystal Park. None of the peaks had any snow on them as yet, but they were beautiful just the same, and a deep blue in the haze of distance.

While I was munching on some nuts, a ground squirrel must have smelled my food. It was darting about from rock to rock, getting closer to me. It watched my every move, standing on its hind legs on boulders. I tossed it a few nuts, and it soon filled its cheeks. Later, I was setting up my camera when I heard a rustling noise nearby. When I turned to see what it was, the squirrel was in my fanny pack, trying to gnaw open the zip-lock nut bag. I must have scared the poor thing out of its wits when I shouted at it. It ran away and didn't come back.

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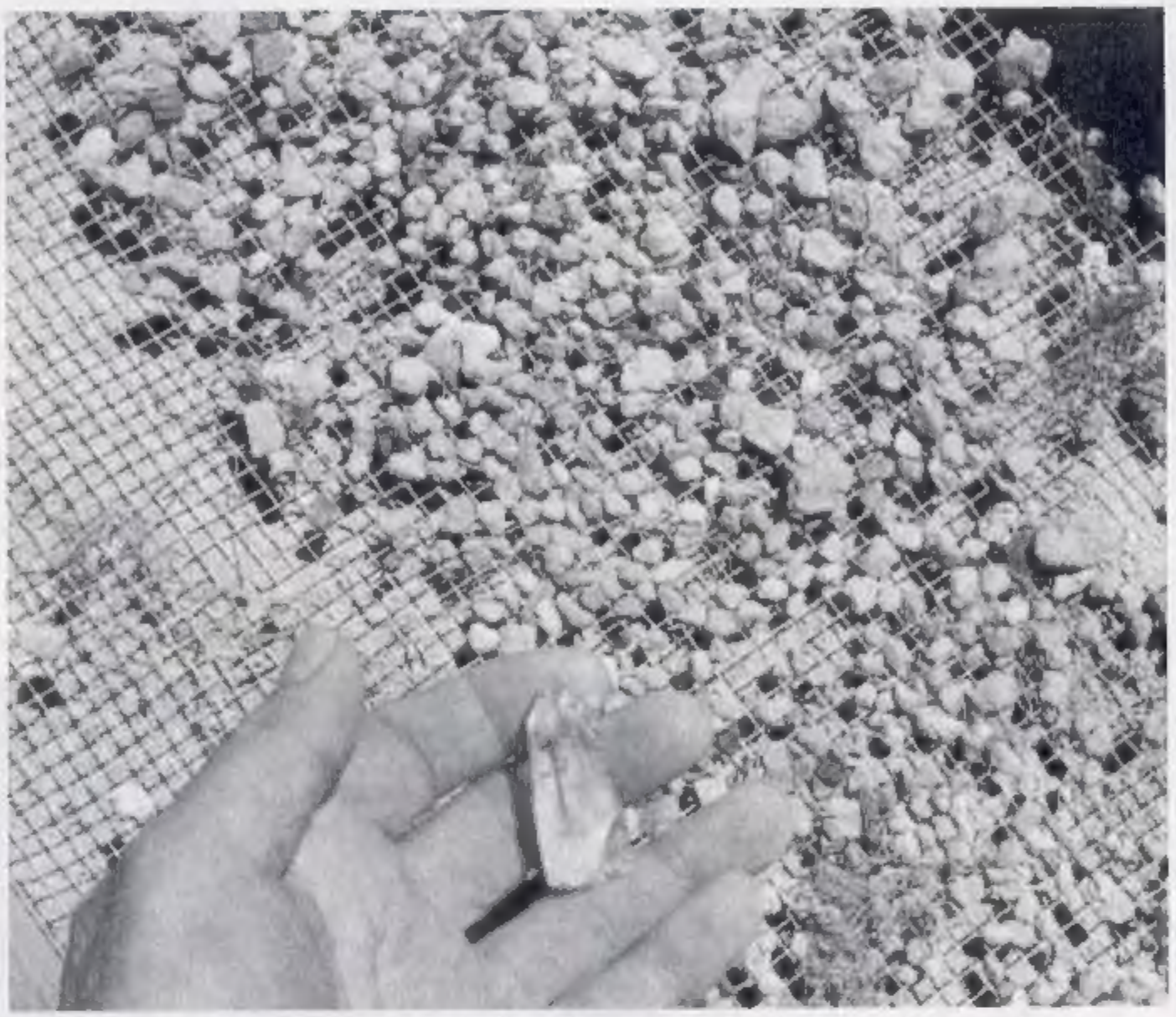
After lunch, I was digging in a different place in the hole when I found a very hard-packed gravel area. It had a rusty appearance; just what I was looking for. I had to work a bit harder at filling the screen because the gravel was so compacted in this spot. When I set the screen down after getting rid of the fine dirt, I was excited to see some beautiful points resting on the mesh. I picked up a perfect, water-clear, doubly terminated crystal. It's about an inch long and ¼ inch in diameter. I had indeed broken into a pocket.

From my experience, the "pockets" here are not crystal-lined openings, but are completely full. The material in this pocket was a very fine, iron-red, dry clay substance, similar to a pegmatite. Quartz crystals tend to grow on the outer walls of a pocket. I didn't actually trace the entire area of this pocket due to the fact that gravel kept dribbling down as fast as I could shovel it away. I'm guessing that it wasn't much bigger than the area I had exposed.

Doubly terminated quartz crystals grow free in these pockets. I don't know how they formed in this way. I wish I did. They haven't actually broken off the walls, but simply lie loose in the pocket, impacted in the clay. The nature of geology and our Earth is indeed miraculous. As a mind-boggling example, why do crystals of almost every species of gemstones form the way they do? That's something that's always intrigued me. The crystalline quartz group always forms in hexagonal crystals. Being that nature isn't always perfect in her handiwork, some of the crystals are deformed. The vast majority have that beautifully terminated shape. I suspect that heat, pressure and gasses have much to do with their formation.

The hole I was digging in contained a variety of different-colored crystals. Most were water clear; I could see my finger and thumb through many of them, even when they were dirty. Some were faint yellow, others had a rusty pink tint. Quite a few had a thin coating of iron oxide on them.

I stuck the shovel into one bottom corner of the hole where the gravel was very red and coarse. When I screened out five shovelfuls of the material, I found a pretty, deep purple amethyst point, along with several clear points. The amethyst is ⅜ inch in diameter and ½ inch long. It looks flawless to the naked eye. It actually could be set in a brooch just as it is. With a sterling silver setting and a matching silver chain, it would be stunning.



The crystal points stand out when the gravel is screened away.

I found a number of smoky quartz crystals in that hole, as well. One point has an unusual blood-red interior. Then I found a prize! I was casually screening a load when something bigger than usual appeared on the mesh. I picked it up and cleaned some of the dirt off. I was looking at a cluster of amethyst crystals resting on a mound of matrix about 2 inches long and 1 inch wide. When I examined it more closely and held it up to the sunlight, I knew I had a prize cabinet specimen. The points are small and stubby, as amethysts tend to be. Some of the points are so perfect they could be cut into faceted stones. I don't want to spoil an excellent cabinet specimen, so I'll wrap it carefully and save it for display. I'm actually surprised that I removed it undamaged from the hole, what with the gouging and chopping I was doing with the shovel. A small pick would come in handy in a situation like this, but I didn't take one along.

I talked with a number of collectors in the park. Everybody was enjoying themselves. One boy proudly showed me his collection for the day; he had found some very nice crystals. He held up one large group of crystals, of which he was especially proud. It filled the palm of his hand.

As the day passed, I was feeling the effects of my toil, but I was having a great time and continued to dig, though I must confess, somewhat more slowly. I played a game with myself. I'd say, Just one more screen and I'll quit. One screen turned into a number of them. The afternoon slipped away and before I realized it, it was time to go. I reluctantly packed up my gear and began the walk down to the truck.

My time spent at Crystal Park ended all too quickly. I was somewhat tired from all that digging and screening, but happy. It had been one fantastic collecting experience, and for only $5. Holders of Golden Age passports, available from the National Park Service (800/GO-PARKS, www.nationalparks.org), pay half price.

If you are in Gold West Country and feel the urge to do some first-class crystal digging, you can't beat Crystal Park. It's a most unusual and beautiful mountain. While you're in the area, it would be well worth your while to visit the gold mining town of Bannack. When I walked the main street of the old ghost town, I felt as though I had stepped back in time. It's so well preserved that one almost expects to see inhabitants step out of the buildings and say "Howdy, stranger!" Bannack is approximately 25 miles west of the city of Dillon on state Route 278. Along the way, you'll see some spectacular scenery and cross over Badger Pass at 6,760 feet.